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PUBLICATION NO. USAEPG-FR-923

SPONSOR: PM-ATACS

FINAL REPORT
DEVELOPMENT TEST II
OF
TIME DIVISION DIGITAL MULTIPLEXER
TD-1069( )/G

BY
LEW BRUCE

NOVEMBER 1976

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SUBJECT: Final Report of Development Test II (DT II) of Time Division Digital Multiplexer (TDDM) TD-1069, TECOM Project No. 6-EE-TD1-069-001, Publication No. USAEPG-FR-923

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
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DRSTE-EL

22 DEC 1976

SUBJECT: TECOM Evaluation of Development Test II (DT II) of Time Division Digital Multiplexer (TDDM) TD-1069, TECOM Project No. 6-EE-TD1-069-001

Project Manager
Army Tactical Communications Systems
Ft. Monmouth, NJ 07703

1. References:

a. ECOM Development Specification EL-CP0138-0001A, 4 May 72, and Amendment No. 4 to EL-CP0138-0001A, 6 Jul 73.

b. Proposed Materiel Need (Engineering Development) for Time Division Digital Multiplexer, 5 Jul 72.

c. Letter, TECOM, AMSTE-EL, 3 Jan 74, subj: Test Directive for Development Test (DT II, Engineering Phase) of Time Division Digital Multiplexer, (TDDM) TD-1069( )/G, TECOM Project No. 6-EE-TD1-069-001.

d. Letter, AMCPM-ATC-TR-9, 30 Jan 73, subj: Coordinated Test Program for Time Division Digital Multiplexer TD-1069( )/G.

e. Final Report, Development Test II (DT II) of Time Division Digital Multiplexer TD-1069( )/G, TECOM Project No. 6-EE-TD1-069-001, Publication No. USAEPG-FR-923, September 76.

f. Test Plan for DT II of Time Division Digital Multiplexer (TDDM) TD-1069, Jul 75, TECOM Project No. 6-EE-TD1-069-001, Publication No. USAEPG-TP-923.

2. Approval Statement:

a. This TECOM evaluation constitutes TECOM's independent evaluation of Time Division Digital Multiplexer (TDDM) TD-1069 for DT II, a non-major uncategorized item. Since testing on this item was initiated prior to

SIDTC, the Independent Evaluation and Test Design Plans (IEP/TDP) were not prepared. Accordingly, this evaluation was prepared in lieu of an Independent Evaluation Report (IER), and has not been coordinated with any other DARCOM command or agency.

b. The inclosed report is approved.

3. Materiel Description: The Time Division Digital Multiplexer (TDDM), TD-1069( )/G is being developed to provide access for teletypewriter (TTY) and digital data signals into the Army Tactical Communications Systems (ATACS). The TDDM will be used in existing Pulse Code Modulated (PCM) radio and telephone terminals such as the AN/TCC-72 and the AN/TRC-117. It is designed to provide the means of multiplexing high speed digital data and/or TTY traffic for transmission over cable or through the ATACS radio and cable trunking facilities.

4. Background:

a. The Proposed Materiel Need (Engineering Development) for the TD-1069 (reference 1b) was approved by DA in December 1972. Subsequent hardware development is being supervised by the PM, ATACS.

b. PM, ATACS requested TECOM conduct DT II testing of engineering prototype models of the TD-1069 (reference 1c).

c. The TD-1069 is designed to combine up to 24 channels of TTY and low to medium speed digital data signals into one 32 kilobits per second (kbs) data stream, which can be interfaced directly into the ATACS transmission system. The TD-1069 will be used to support tactical automatic data processing systems such as TACFIRE, TOS and others which the Army plans to field in the near future.

5. Scope of Test:

a. DT II of the TD-1069 was conducted in accordance with the approved test plan (reference 1f) to:

(1) Determine the degree to which the test item and its associated maintenance test package met the technical performance characteristics specified in requirements documents (references 1a and 1b).

(2) Determine safety and human factors characteristics of the test item.

(3) Provide estimates of reliability, availability and maintainability of the test item.

(4) Verify adequacy of the maintenance test package.

(5) Evaluate compatibility of the test item when used with appropriate equipment/assemblages.

b. All testing was performed by US Army Electronic Proving Ground (USAEPG) during the period November 1975 through November 1976 at Ft. Huachuca, Arizona, except for vehicular and rail transport and drop tests. These were conducted at Tobyhanna Army Depot and Sacramento Army Depot and were witnessed by USAEPG representatives.

c. Ten test items were initially provided for test. An additional eight items were provided for systems testing along with the modified ATACS assemblages.

6. Technical Assessment:

a. Overall Assessment:

(1) The test item is safe to operate and maintain.

(2) The Time Division Digital Multiplexer (TDDM) TD-1069 will combine up to 24 channels of teletypewriter (TTY) and low to medium speed digital data signals into one 32 kilobits per second (kbs) data stream.

(3) The test item exhibited deficiencies in the areas of humidity, special tools and repair parts.

(4) The test item exhibited shortcomings in the areas of safety, humidity, salt fog, fungus, human factors, built-in test facilities and design for maintainability.

b. Detailed Assessment: Three deficiencies are identified in the inclosed report.

(1) Deficiencies (3):

(a) The power supply of the test item is subject to failure in high humidity. (Deficiency 1.1, page B-1 of inclosure.) Correction is considered to be low risk. See paragraph 7.

(b) Tool kit TK-105/G does not provide a tool to remove hex nuts from the connectors. The lack of a proper tool in tool kit TK-105/G prevents the completion of authorized direct support maintenance. (Deficiency 1.2, page B-1 of inclosure.) Correction is considered to be low risk.

(c) Repair parts are not listed by group numbers following the Maintenance Allocation Chart (MAC) group numbers. This will cause delay in completion of maintenance operations. (Deficiency 1.3, page B-1 of inclosure.) Correction is considered to be low risk.

(2) Shortcomings (8): Eight shortcomings are identified by USAEPG in the inclosed report. Shortcomings were disclosed in the following areas: safety, humidity, fungus, salt fog, human factors, built-in test facilities, and design for maintainability. Correction of all shortcomings is considered low risk.

(3) Reliability and Maintainability:

(a) The TD-1069 exceeded the reliability criterion of a mean time between failure (MTBF) of 2500 hours. Combining contractor data, 6084 hours with three chargeable failures, and USAEPG data, system test of 4102 hours with no chargeable failures and bench tests of 399 hours with no chargeable failures, the overall point estimate MTBF was $\frac{10585}{3} = 3528$ hours, and it can be stated with 80 percent confidence that the true MTBF was bracketed by the interval 1584 hours $\leq$ true MTBF $\leq$ 9605 hours.

(b) The TD-1069 had a demonstrated maximum corrective maintenance time of 0.57 hours based on 13 actions and this met the requirement of a maximum corrective maintenance time no greater than 1 hour (95th percentile). Based on the 13 maintenance actions requiring 4.8 manhours, the demonstrated mean time to repair (MTTR) of 22 minutes at the organizational level did not meet the criterion of 15 minutes; however, this is not considered excessive for this type of equipment. The high MTTR can be attributed to the 10 problem areas listed under Design for Maintainability (Shortcoming) and also the inadequacy of the maintenance test support package (MTSP). The evaluation of the MTSP disclosed the deficiencies and shortcomings as addressed in paragraph 6b.

7. Comment: Considering that the test item is employed only in shelterized configurations with other ATACS equipments, humidity requirements for the test item appear stringent. The validity of the current humidity requirement should be investigated.

2 DEC 1976

DRSTE-EL
SUBJECT: TECOM Evaluation of Development Test II (DT II) of Time Division Digital Multiplexer (TDDM) TD-1069, TECOM Project No. 6-EE-TD1-069-001

8. Conclusions:

a. The test item is reliable and is safe to operate and maintain.

b. The test item is compatible with the TD-1065 High Speed Serial Data Buffer and other ATACS system assemblages and performs its intended function.

9. Recommendations:

a. That current humidity criteria be revalidated.

b. That the other two deficiencies and as many shortcomings as feasible be corrected and verified during initial production.

FOR THE COMMANDER:

Walter L. Mayo, Jr.

1 Incl
as

WALTER L. MAYO, Jr.
Colonel, GS
Deputy to the CG for Testing

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REPORT DOCUMENTATION PAGE

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The US Army Electronic Proving Ground conducted a DT II of Time Division Digital Multiplexer TD-1069 to determine to what extent it meets requirements of the development specification EL-CP0138-0001A and to evaluate safety, reliability, availability, and maintainability. Findings revealed that the technical performance of the TD-1069 is unsatisfactory due to power supply failures during humidity cycling, lack of a tool to remove connector hex nuts, difficulty in using repair parts list, and marginal susceptibility to humidity, salf-fog, and fungus.

(continued)

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Item 20 continued

The test item was safe to operate and maintain except for sharp corners and edges, exposed voltages in power supply module, and lack of warning labels on printed circuit boards.

Human factors characteristics were satisfactory except for improper color on display panel, difficulty in installing/removing cables in shelter-mounted configuration, and inaccessibility of the channel assignment switch.

The reliability, availability, and maintainability characteristics of the test item were satisfactory. Recommend the deficiencies and as many shortcomings as feasible be corrected.

SUMMARY OF RESULTS

1. The technical performance of the test item was unsatisfactory due to power supply failures during humidity cycling (deficiencies). The maintenance test package was unsatisfactory due to lack of a tool to remove connector hex nuts and difficulty in using repair parts list (deficiencies). The test item was marginally susceptible to humidity, salt-fog, and fungus (shortcomings).

2. The test item was safe to operate and maintain except for three marginal hazards (shortcomings): Sharp corners and edges, exposed voltages in power supply module, and lack of warning labels on printed circuit boards.

3. Human factors characteristics were satisfactory except for improper color on display panel, difficulty in installing/removing cables in shelter-mounted configuration, and inaccessibility of channel assignment switch (shortcomings).

4. The reliability, availability, maintainability characteristics of the test item were satisfactory except that the built-in test facility would not isolate all defective modules and the design for maintainability was inadequate (shortcomings).

5. The test item exhibited satisfactory compatibility characteristics when interconnected in a system configuration and with subscriber equipment.

FOREWORD

The US Army Electronic Proving Ground (USAEPG), Fort Huachuca, Arizona, was responsible for test planning, execution, and reporting.

Numerous personnel within USAEPG provided valuable assistance to the author in the timely completion of this test program and the technical accuracy of this document. The ones who deserve special recognition are Joe Kintner, Dave Spahr, SSG Paul Fillion, and the enlisted personnel of Switching and Terminal Systems Section; LT. Geronimo, and Emelda Colanto of the Environmental Test Facility; Keith Hakes, Doug Hunton, and Frank Leyva of the Electromagnetics Branch; Raleigh Taylor and the typing crew of the Technical Publications Branch; and Bill Dunn, Ed Kawamura, and Jeff Abraham of Materiel Test Division.

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

a. The Time Division Digital Multiplexer TD-1069( )/G is being developed to provide access for teletypewriter (TTY) and digital data signals into the Army Tactical Communications System (ATACS) pulse code modulation (PCM) transmission equipment. The TD-1069 will combine up to 24 channels of TTY and low to medium speed digital data signals into one 32 kilobits per second (kb/s) data stream. This data stream can be interfaced directly (when using the High Speed Serial Data Buffer TD-1065) into the ATACS PCM transmission system. The TD-1069 will be used to support tactical automatic data processing systems such as TACFIRE, TOS, and others, which the Army plans to field in the near future.

b. The Proposed Materiel Need (Engineering Development) for the TD-1069 (ref 25, app F) was approved by DA in December 1972. Subsequent hardware development is being supervised by Project Manager, ATACS, who requested the US Army Test and Evaluation Command (TECOM) to conduct a Development Test (DT II) of engineering prototype models of the TD-1065. TECOM assigned this responsibility to the US Army Electronic Proving Ground (USAEPG).

1.2 DESCRIPTION OF MATERIEL

a. The TD-1069, the test item (fig. 1), is designed to be installed in existing ATACS telephone and radio terminal assemblages such as the AN/TCC-72 and AN/TRC-117.

b. The TD-1069 is designed to occupy a volume of less than 2.0 cubic feet and mount in a standard 19-inch equipment rack.

c. The TD-1069 is designed to provide up to 24 TTY (45.5, 50, 75, and 150 b/s) and/or digital data (600, 1200, 2400, 4800, and 9600 b/s) channel and combine them into one 32 kb/s data stream.

d. The TD-1069 is designed to operate from single phase ac power sources providing 115 volts ±10 percent at 50, 60, or 400 Hz ±5 percent.

e. The TD-1069 will be capable of operating independently of the ATACS equipment by transmitting the multiplexed signals directly to another TD-1069.

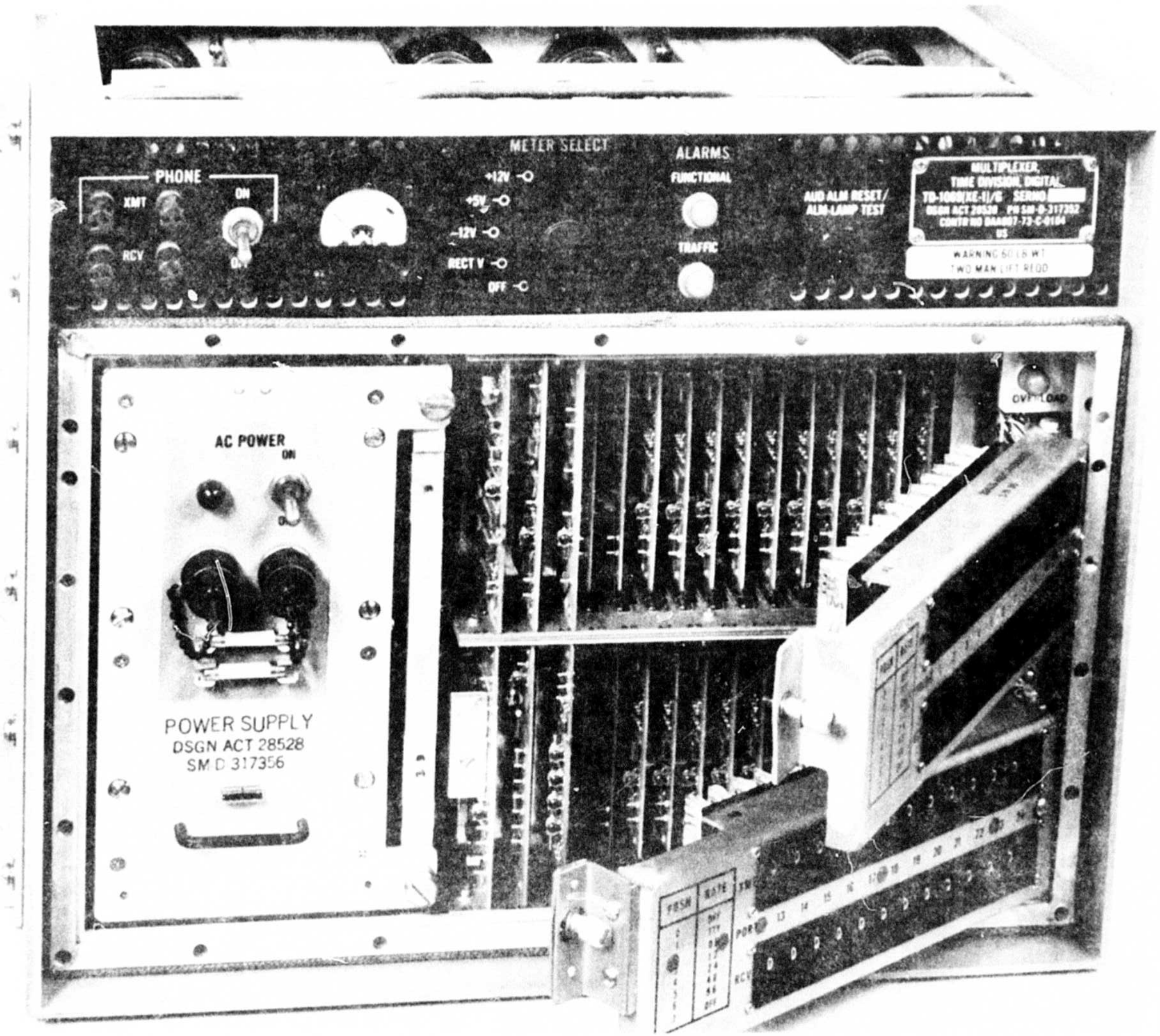

Figure 1. Time Division Digital Multiplexer TD-1069.

1.3 TEST OBJECTIVES

The test objectives were --

a. To conduct an independent evaluation to determine the degree to which the test item and its maintenance test package meet the technical performance characteristics specified in the development specification.

b. To determine the safety and human factors characteristics of the test item.

c. To provide estimates of the reliability, availability, and maintainability of the test item.

d. To verify adequacy of the maintenance test package.

e. To evaluate the compatibility of the test item when used with appropriate equipment/assemblages.

1.4 SCOPE

a. All testing was performed by USAEPG, during the period November 1975 through November 1976, at Fort Huachuca, Arizona, except for vehicular transport, rail transport, and drop testing that was conducted at Tobyhanna and Sacramento Army Depots.

b. Criteria for testing were taken from the development specification EL-CP0138-0001A with Amendment No. 4, dated 6 July 1973, and applicable military standards.

c. Ten test items were initially provided for test. An additional eight items were provided for systems testing (see para 2.21) along with the modified ATACS assemblages.

d. In addition to the itemized test data recorded, the following was collected for each subtest:

(1) Serial number of each test item.

(2) Complete nomenclature, manufacturer, serial number, and latest calibration date of all test equipment.

(3) Date, location, and type of test.

(4) Names and MOS's of all test personnel.

(5) Photographs of significant results.

(6) Any adverse or unusual conditions that affect the testing.

e. Test data from sources other than USAEPG was not used except for the data derived during the depot testing.

SECTION 2. DETAILS OF TEST

2.1 SAFETY

2.1.1 Objective

The objective was to determine if the test item is safe to operate and maintain.

2.1.2 Criteria

The test item shall meet the pertinent safety requirements of MIL-STD-454D and EL-CP0138-0001A, paragraph 3.18.

2.1.3 Data Acquisition Procedure

a. A safety engineer and the test officer conducted a safety survey of the test item.

b. A continuous safety surveillance was maintained by project personnel throughout testing to detect and define material, design, handling, or other factors that might present safety hazards to personnel or equipment.

c. Test personnel recorded any unsafe conditions noted during the test.

d. A safety statement was received from the developer.

e. A safety release recommendation was submitted in accordance with TECOM Supplement 1 to AMCR 385-12.

f. Soldier-operator-maintainer tester comments were solicited.

2.1.4 Results

During the safety survey and conduct of the test, the following findings were observed and recorded:

a. Extremely sharp corners and edges exist on the printed circuit card guides, card extractor holder, and on the switch gate assemblies. On some printed circuit boards, component pins protruded through the boards.

b. There are numerous exposed voltages in excess of 70 volts within the power supply assembly.

c. There are no caution labels on the circuit cards specifying that special handling is required due to MOS incorporated on the printed circuit card. The cards are easily damaged by static electricity.

d. Soldier-operator-maintainer tester comments are included in appendix D, Part A.

2.1.5 Analysis

a. The sharp corners, edges, and protruding component pins constitute a marginal hazard because personnel may sustain injury during the performance of organizational and direct support maintenance functions.

b. The exposed voltages in excess of 70 volts constitute a marginal hazard due to personnel injury that may be sustained when the maintainer makes contact with the exposed voltages.

c. The lack of a caution label warning the operator-maintainer-logistic personnel of special handling requirements to prevent damage to the modules containing metal oxide semiconductant (MOS) constitute a hazard as personnel may not remember or even know that MOS devices can be damaged by mishandling/improper packing.

d. The equipment is safe to operate and maintain except for items listed in paragraphs a through c above which constitute a shortcoming.

2.2 PHYSICAL CHARACTERISTICS

2.2.1 Objective

The objective was to determine the size and weight of the test item.

2.2.2 Criteria (ELCP0138-0001A)

a. The width shall not exceed 17¼ inches (cm). The depth shall not exceed 12 inches (cm). The height shall not exceed 14 inches (cm). (Para 3.4)

b. The weight of the test item shall not exceed 60 pounds. (27.27 Kg) (Para 3.5)

2.2.3 Data Acquisition Procedure

The dimensions and weight of the test items (SN 09, 12, 16, 20, and 24) were measured by the USAEPG Calibration Lab.

2.2.4 Results

The results of the measurements are tabulated in table I.

TABLE I. PHYSICAL CHARACTERISTICS

Test Item SN	Height (in.)	Width (in.)	Depth (in.)	Weight (lbs-oz)
09	13.97	17.27*	12.27*	56-12
12	13.97	17.25	12.27*	56-13
16	13.98	17.27*	12.27*	56-14
20	13.97	17.25	12.30*	56-14
24	13.97	17.26*	12.30*	56-11

*Fall outside criteria limits

2.2.5 Analysis

The size and weight of the test item fell within the specified limits, except for the minor noncompliances shown above. The test item is considered to have met the criteria.

2.3 VISUAL AND MECHANICAL CHARACTERISTICS

2.3.1 Objective

The objective was to determine if the test item conforms to the standards of good workmanship, completeness of equipment components, and the adequacy of the mechanical configuration.

2.3.2 Criteria (EL-CP0138-0001A)

a. Workmanship of the equipment shall conform to Requirement 9 of MIL-STD-454D. (Para 3.23)

b. The test item shall have the chassis and case integrated as a combination case in accordance with RDD-STD-2. The case shall be equipped with two handles for carrying. The handles shall not interfere with the ability to rack mount the equipment in a standard electronic equipment rack having dimensions conforming to MIL-STD-189. Mounting shall be accomplished by means of mounting brackets. (Para 3.6)

2.3.3 Data Acquisition Procedure

a. All test items were examined for defects in workmanship as listed in MIL-STD-252B. All items were also inspected for conformance with MIL-STD-454D, Requirement 9.

b. The test item cases were examined for compliance with RDD-STD-2.

c. Test items were rack mounted in the modified ATACS assemblages to determine the adequacy of installation hardware as follows:

Assemblage	No. of TD-1069's Installed
AN/TCC-69	2
AN/TCC-72	2
AN/TRC-117	2
AN/TRC-145	2

2.3.4 Results

a. During the initial inspection of the test items, it was noted that several of the bulkhead printed circuit board connectors had some pin sockets that were either pushed in or deformed. Later in the test program, a second inspection of the items, revealed that many of the problems were self correcting.

b. The test item cases were found to be noncompliant with RDD-STD-2.

c. No problems were encountered in installing the test items in the modified ATACS assemblages.

2.3.5 Analysis

a. The problems with the connectors did not degrade the operational performance of the test item (see subtest 2.4), therefore, they are not considered significant. The workmanship of the TD-1069 is considered adequate and the mechanical design conforms to the specification.

b. The requirement for an integrated chassis and case in accordance with RDD-STD-2 was waived by the developer (ECOM) since the deployment of the item is in shelter assemblages only (app E, ref 29). The test item case met the remainder of the requirement listed in criteria para b.

2.4 OPERATIONAL CHARACTERISTICS

2.4.1 Objective

The objective was to determine the operational characteristics of the TD-1069 when operated in the various modes of data transmission.

2.4.2 Criteria (EL-CP0138-0001A)

a. Data inputs may be at rates of 600, 1200, 2400, 4800, or 9600 bits per second (b/s). (Para 3.2)

b. The transmit and receive section of a data channel in the TD-1069 shall be completely independent with respect to bit rate processing capability. (Para 3.2)

c. The TD-1069 shall be capable of interfacing balanced conditioned diphase modulated data streams at any of the data rates cited in paragraph a above. The data sources shall conform to MIL-STD-188C requirements for data transmission. The TD-1069 shall extract timing from these data streams. (Para 3.2.6.1a)

d. The TD-1069 shall be capable of interfacing balanced non-return to zero (NRZ) data streams each with associated timing streams at rates cited in paragraph a above. The sources of these data and timing signals will be transistor-transistor logic (TTL) elements. At the source, voltage levels from 0.0 to +0.4 volt shall denote a logic "0"; voltage levels from +2.4 to +5.0 volts shall denote a logic "1". (Para 3.2.6.1c)

e. Binding posts shall be provided on the front panel of each TD-1069 for the interconnection of four-wire telephone such as the TA-341 to be used as an analog orderwire when no data traffic is carried in either direction. (Para 3.2.1)

2.4.3 Data Acquisition Procedure

a. The test was set up as shown in figure 2.

b. The data generator was set to the MIL-STD data format and a 5-minute block of test data was transmitted. The resultant bit errors, if any, were noted.

c. Step b above was repeated at test data rates of 600, 1200, 2400, 4800, and 9600 b/s.

d. Steps b and c above were repeated on all twenty-four channels of each test item.

e. An abbreviated version of steps b through d above was repeated on the test item using test data in the TTL format.

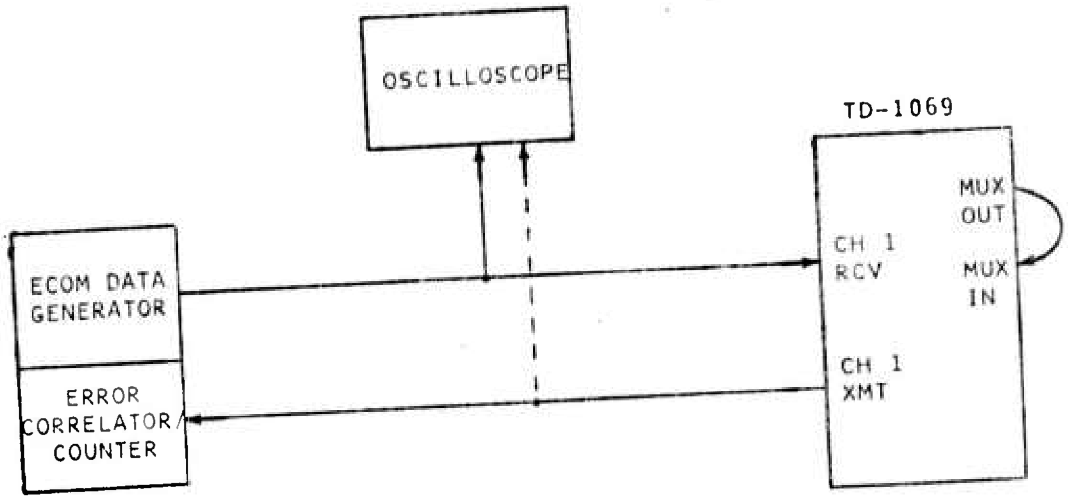

Figure 2. Operational test configuration.

f. The orderwire check was set up as shown in figure 3. The PHONE ON/OFF switch was switched to the ON position and voice communication was verified.

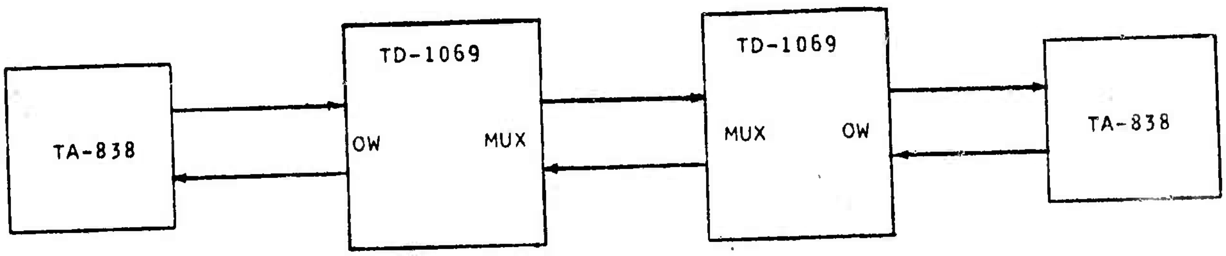

Figure 3. Orderwire configuration.

g. A full duplex operation was then set up as shown in figure 4. The output of one data generator was set to 9600 b/s and the other at 4800 b/s. A 5-minute block of test data was transmitted in both directions, simultaneously, and the resultant errors, if any, noted.

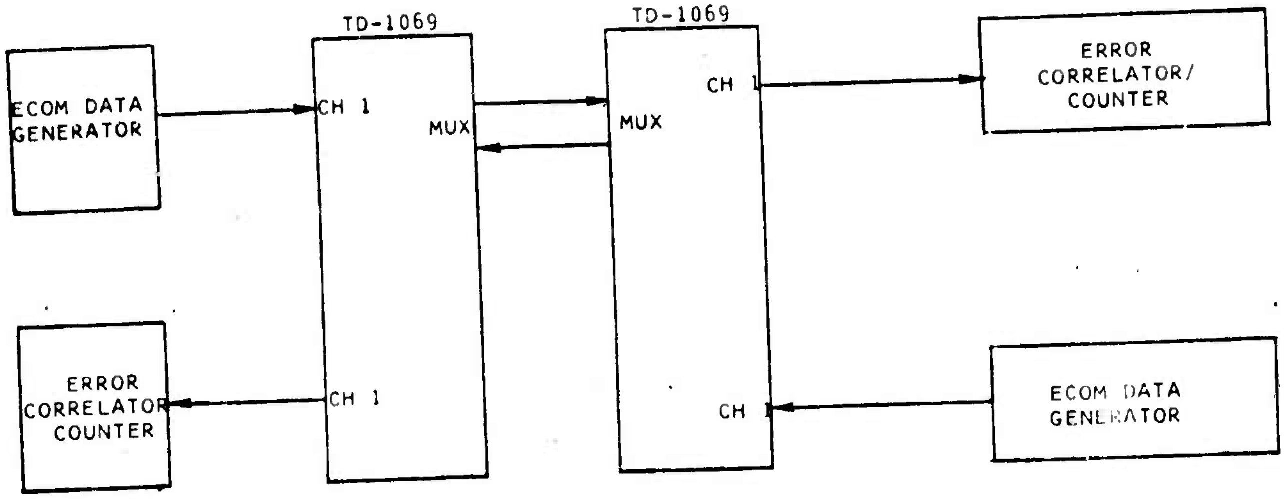

Figure 4. Full duplex operational configuration.

h. Step g above was repeated using other channels and the different data rates as follows:

Channel 5:	4800 and 2400 b/s
Channel 10:	2400 and 1200 b/s
Channel 15:	1200 and 600 b/s
Channel 20:	600 and 9600 b/s

i. This entire procedure (steps a through h above) was repeated using the ten test items (SN 09, 10, 12, 13, 16, 17, 20, 21, 22, and 24).

2.4.4 Results

a. During the preoperational inspection, five defective printed circuit boards (PCB) were found; one reference frequency generator (SN 18B) and four port modules (SN 273B, 510B, 516B, and 667B). During an evaluation conducted later in the test program, the faults originally indicated on port modules (SN 510B and 516B) could not be duplicated. The other three failures were verified. ECOM COMM/ADP Labs conducted fault isolation on the defective PCB's and found the following:

Item	Defect
Reference Frequency Generator SN 18B	A cold solder joint on the PCB inside the potted crystal oscillator module.
Port Module SN 273B	Defective LSI chip No. 1131600.
Port Module SN 667B	Defective LSI chip No. 1131601.

b. After replacement of defective components (para a above), there were no bit errors encountered during any of the operational checks on any item in both the MIL-STD and TTL data modes.

c. The orderwire on each item operated properly.

d. Operation in the full duplex mode was satisfactory. There were no bit errors encountered.

2.4.5 Analysis

a. The failure of the reference frequency generator (1 out of 10) and the port modules (2 out of 240) are isolated cases and not indicative of poor workmanship or design problems.

b. The test results indicate that there are no operational problems with the test item in either the MIL-STD or TTL modes at any of the 5 (600, 1200 2400, 4800, and 9600 b/s) data rates.

c. The test item met the criteria.

2.5 CHANNEL IMPEDANCE

2.5.1 Objective

The objective was to determine the input and output impedance of the data channel ports.

2.5.2 Criteria (EL-CP0138-0001A)

a. The input resistance of a channel specified to receive signals from balanced MIL-STD-188C drivers shall not be less than 6000 ohms between terminals of a port. (Para 3.2.6.4a)

b. The channel output impedance of the MIL-STD-188C drivers shall not exceed 100 ohms. (Para 3.2.6.7)

c. The input resistance of a channel specified to receive signals from balanced TTL drivers shall be nominal 130 ohms between terminals of a port. (Para 3.2.6.4b)

2.5.3 Data Acquisition Procedure

a. Input Impedance.

(1) The test was set up as shown in figure 5.

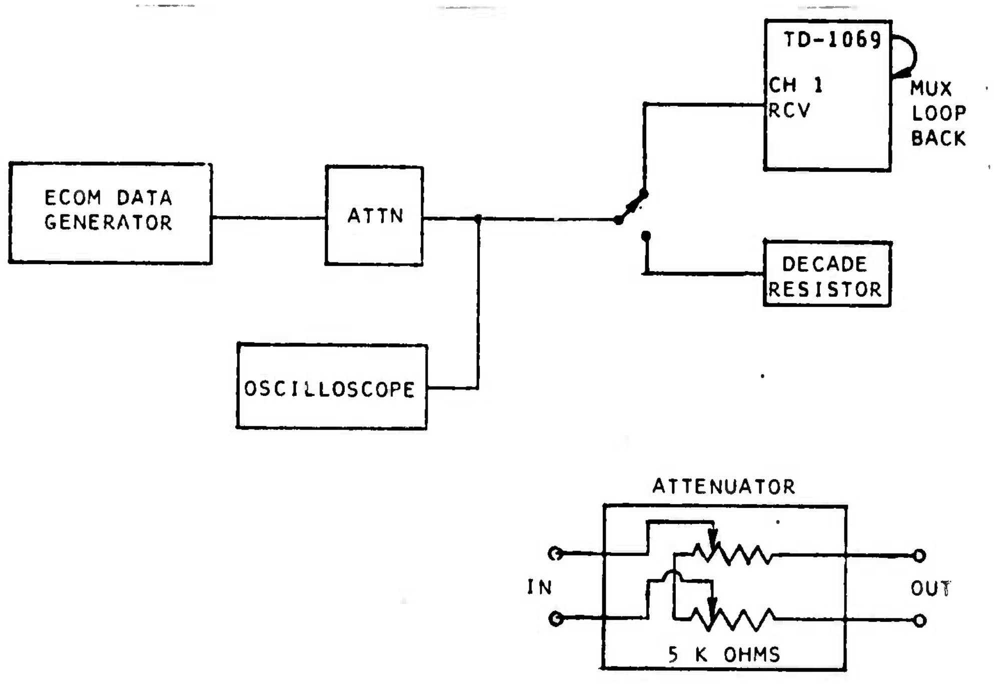

Figure 5. Input impedance test configuration.

(2) The data generator output was adjusted to 12 volts peak-to-peak (Vp-p) as observed on the oscilloscope using the attenuator.

(3) Switch S-1 was then set to the decade resistor position. The decade resistor was adjusted until the 12-Vp-p level was observed on the oscilloscope.

(4) The setting on the decade resistor was noted.

(5) Steps (1) through (4) above were repeated using data at 600, 1200, 2400, 4800, and 9600 b/s on channels 1, 5, 10, 15, and 20 of each test item.

(6) Steps (1) through (5) above were repeated using data in the TTL mode on both the data and timing input ports.

(7) Steps (1) through (6) above were repeated using five test items (SN 09, 12, 13, 17, and 24).

b. Output Impedance.

(1) The test was set up as shown in figure 6.

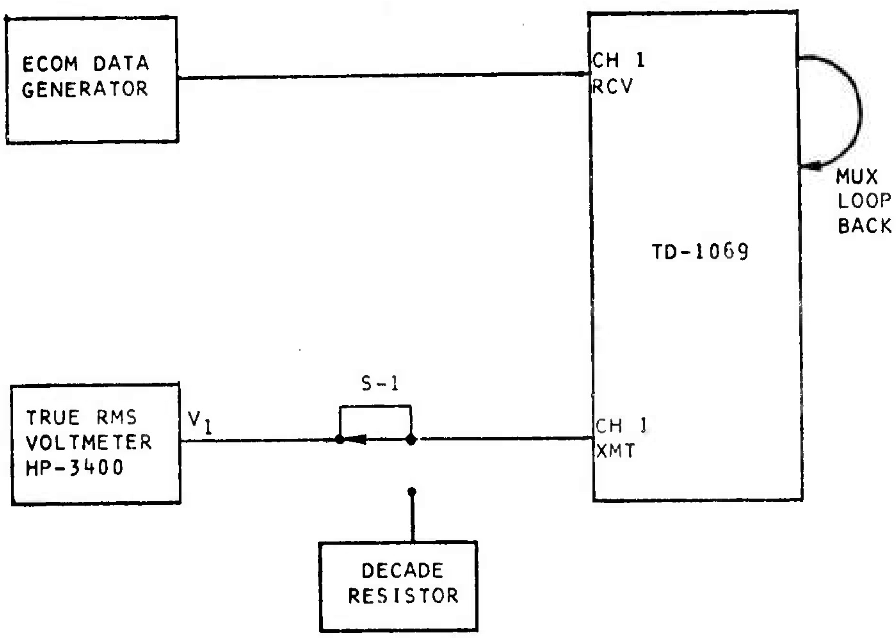

Figure 6. Output impedance test configuration.

(2) The data generator was set to the desired data rate. The reading (V_1) on the true root mean square (rms) voltmeter was noted.

(3) Switch S-1 was then set to the decade resistor position. The decade resistor was adjusted until a reading of $\frac{1}{2}V_1$ was obtained on the voltmeter.

(4) The setting on the decade resistor was noted.

(5) Steps (1) through (4) above were repeated using data at 600, 1200, 2400, 4800, and 9600 b/s on channels 1, 5, 10, 15, and 20 of each test item.

(6) Steps (1) through (5) above were repeated using data in the TTL mode on both the data and timing input ports.

(7) Steps (1) through (6) above were repeated using five test items (SN 09, 12, 13, 17, and 24).

2.5.4 Results

The results of the channel input impedance test on the MIL-STD data, TTL data, and TTL timing ports are shown in table II. Output impedance results are shown in table III. The data shown in the tables is averaged for the five items tested. All impedance values are in ohms.

TABLE II. CHANNEL INPUT IMPEDANCE TEST RESULTS (IN OHMS)

Channel	Test Data Rate (b/s) 600	1200	2400	4800	9600
			MIL-STD Data		
1	11600	10800	9800	9800	9000
5	12000	11000	11000	10000	9800
10	11800	11400	10800	10000	9200
15	11800	11200	10800	10200	9000
20	12000	11800	10600	10200	10000
Mean	11840	11240	10600	10040	9400
			TTL Data		
1	100	102	102	104	104
5	104	106	104	108	108
10	104	98	94	94	96
15	96	97	96	96	98
20	94	92	91	91	89
Mean	100	99	97	99	99
			TTL TIMING		
1	104	104	105	104	105
5	102	104	108	106	106
10	99	98	97	95	96
15	98	96	96	96	96
20	98	98	98	97	94
Mean	100	100	101	100	99

TABLE III. CHANNEL OUTPUT IMPEDANCE TEST RESULTS (IN OHMS)

	Test Data Rate (b/s)				
Channel	600	1200	2400	4800	9600
			MIL-STD Data		
1	65	65	66	66	66
5	65	65	65	65	64
10	65	66	66	67	65
15	65	65	65	65	65
20	65	64	64	65	64
Mean	65	65	65	66	65
			TTL Data		
1	78	80	82	80	81
5	82	82	80	81	82
10	80	81	80	81	82
15	81	81	82	82	82
20	81	80	80	79	79
Mean	80	81	81	81	81
			TTL Timing		
1	80	79	80	81	81
5	82	82	82	82	81
10	79	81	82	81	80
15	81	80	81	82	81
20	81	80	80	79	80
Mean	81	80	81	81	81

2.5.5 Analysis

a. The input impedance of the MIL-STD data ports decreases as the data rate goes up. It varies from approximately 12000 ohms at 600 b/s to approximately 9000 ohms at 9600 b/s. This surpasses the specified limit of "not less than 6000 ohms."

b. The output impedance of the MIL-STD data ports was a nominal 65 ohms at all data rates. This exceeds the specified limit of "not to exceed 100 ohms."

c. The input impedance of the TTL data and timing ports was a nominal 100 ohms at all data rates. This does not meet the specified requirement of a "nominal 130 ohms." The output impedance of the TTL data and timing ports was a nominal 80 ohms at all data rates. This does not meet the specified requirement of a "nominal 130 ohms." There was no evidence of degradation of performance as a result of this noncompliance.

2.6 CHANNEL LONGITUDINAL BALANCE

2.6.1 Objective

The objective was to determine the longitudinal balance of the data channel ports.

2.6.2 Criterion (EL-CP0138-0001A, para 3.2.6.3.1)

The longitudinal balance of each pair configured for the reception and transmission of either conditioned diphase modulated data or teletypewriter traffic shall not be less than 40.0 dB.

2.6.3 Data Acquisition Procedure

a. Longitudinal Balance (Input Ports).

(1) The test was set up as shown in figure 7. Initially, the bridging resistors R_3 and R_4 were connected between points A and B instead of the test item.

(2) The signal generator output was set to 3 Vp-p at 600 Hz. Potentiometer R_5 was adjusted until a minimum reading was obtained on the true rms voltmeter (V_2).

(3) The bridging resistors were then removed and the test item connected as shown in figure 7.

(4) The rms voltage readings (V_1 and V_2) were noted.

(5) Steps (1) through (4) above were repeated using test frequencies of 1200, 2400, 4800, and 9600 Hz on channels 1, 8, 10, 15, and 20 of each test item.

(6) Steps (1) through (5) above were conducted using five test items (SN 10, 16, 20, 21, and 22).

(7) The longitudinal balance was then calculated using the equation: Longitudinal Balance (dB) = $20 \log V_1/V_2$.

b. Longitudinal Balance (Output Ports).

(1) The test was set up as shown in figure 8.

(2) The data generator was set to 600 b/s and connected to channel 1 receive ports.

(3) The dc component of the output signal (Vdc_1 and Vdc_2) was measured using the oscilloscope. The rectified ac component of the output signal level ($Vp\text{-}p_1$ and $Vp\text{-}p_2$) was measured using the digital voltmeter.

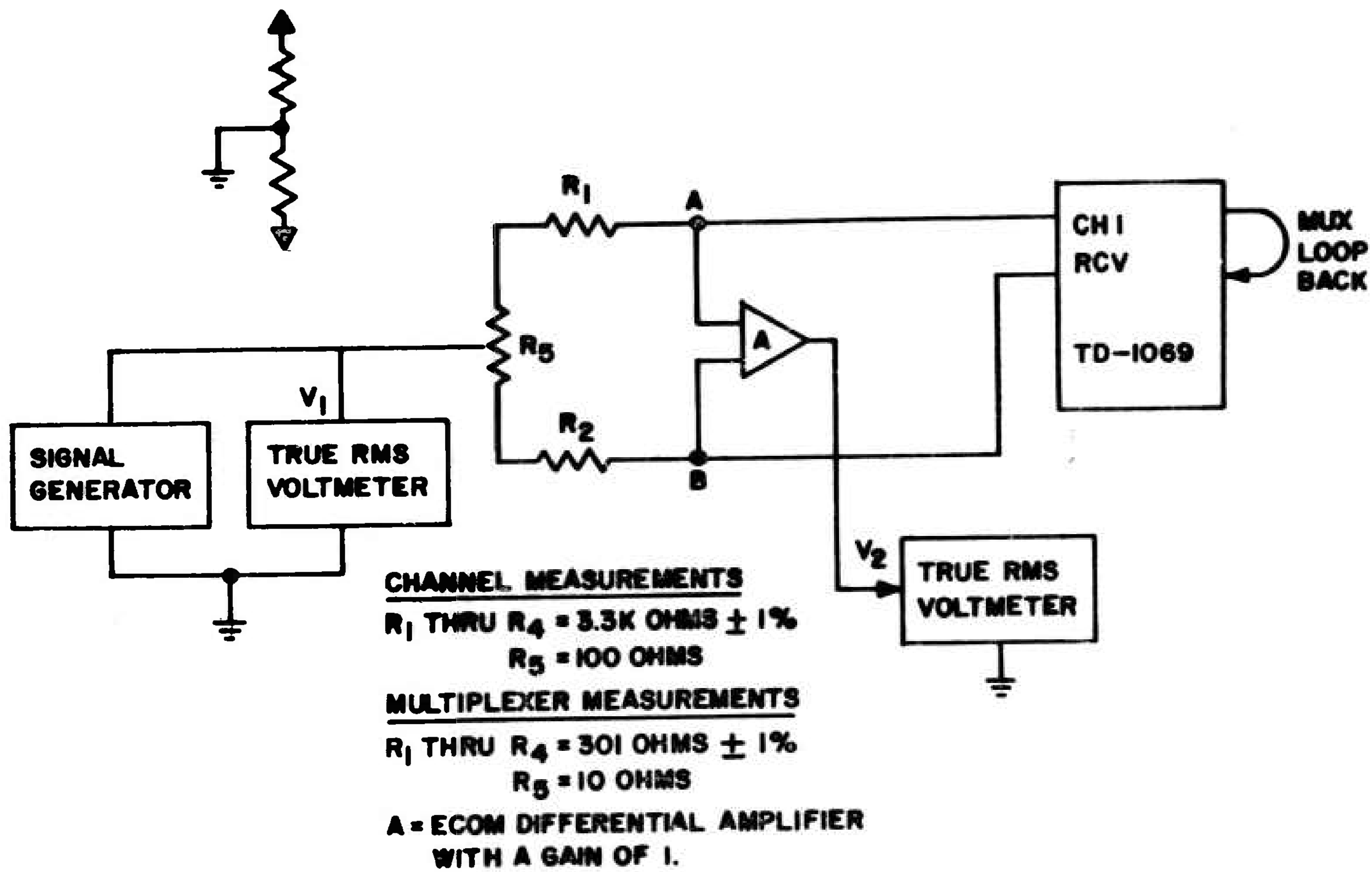

Figure 7. L.ngitudinal balance (input ports) test setup.

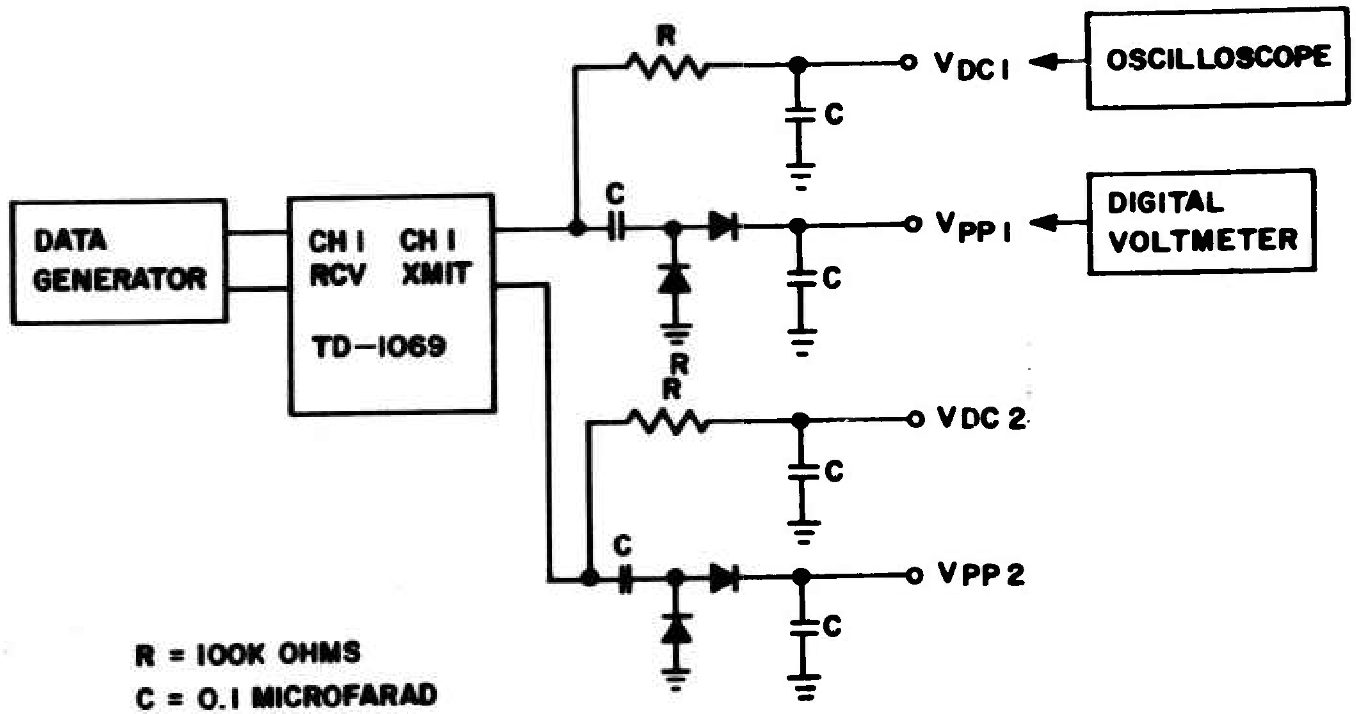

Figure 8. Longitudinal balance (output ports) test setup.

(4) Steps (1) through (3) above were repeated using test data rates of 1200, 2400, 4800, and 9600 b/s on channels 5, 10, 15, and 20, respectively, of each item tested.

(5) Steps (1) through (4) above were conducted using five test items (SN 10, 16, 20, 21, and 22).

(6) The longitudinal balance was then calculated using the equation:

$$\text{Longitudinal Balance (dB)} = 20 \log \frac{4 \left| Vdc_1 - Vdc_2 \right|}{Vp\text{-}p + Vp\text{-}p} + 2.4$$

2.6.4 Results

a. Results of the channel input ports longitudinal balance test are shown in table IV.

b. Results of the channel output ports longitudinal balance test are shown in table V.

2.6.5 Analysis

a. The channel input longitudinal balance was found to be a nominal 60 dB. This falls within the specified limit of "not less than 40 dB."

b. The channel output longitudinal balance was found to vary between 33 and 57 dB. Two of the 25 measurements exceeds the specified limit of "not less than 40 dB," however, there was no evidence of degradation of performance as a result of this noncompliance.

TABLE IV. CHANNEL LONGITUDINAL BALANCE (INPUT PORTS) TEST RESULTS (IN DB)

Channel	Test Frequency (Hz) 600	1200	2400	4800	9600
			SN 10		
1	59.3	59.1	59.4	58.9	58.3
5	59.6	59.6	59.5	59.2	58.3
10	59.3	59.2	59.1	58.6	57.7
15	58.3	58.0	58.3	58.0	56.9
20	58.0	58.0	58.0	57.7	56.6
			SN 16		
1	57.4	57.7	57.7	57.4	56.4
5	58.6	58.6	58.6	58.0	56.9
10	58.9	58.9	58.6	58.3	57.1
15	58.6	58.6	58.6	58.3	57.0
20	59.2	59.2	58.9	58.6	57.4
			SN 20		
1	58.0	58.0	58.0	57.7	56.6
5	55.9	56.1	55.9	55.7	55.0
10	60.1	60.0	60.0	59.7	58.3
15	61.7	61.2	61.2	60.8	59.3
20	60.0	61.2	59.6	59.3	58.3
			SN 21		
1	60.4	60.2	60.2	60.0	58.3
5	60.4	60.4	60.4	60.0	58.6
10	59.3	59.6	59.3	58.9	57.4
15	60.0	60.0	59.6	59.3	57.7
20	57.3	57.7	58.0	57.8	55.1
			SN 22		
1	61.2	61.2	60.8	60.0	58.3
5	58.6	59.6	59.7	58.7	55.7
10	62.1	62.1	61.7	61.2	59.3
15	61.7	61.7	61.2	60.4	58.6
20	58.9	60.0	60.0	58.6	55.9

TABLE V. CHANNEL LONGITUDINAL BALANCE (OUTPUT PORTS) TEST RESULTS (IN DB)

Channel	1	5	10	15	20
Test	Test Data Rate (b/s)				
Item	600	1200	2400	4800	9600
SN 10	42.7	44.6	41.2	47.3	42.6
SN 16	42.6	50.6	50.7	41.1	44.8
SN 20	56.6	44.6	41.2	56.8	41.1
SN 21	42.7	44.7	44.7	47.2	33.2
SN 22	36.7	39.9	56.8	56.6	47.4

2.7 CHANNEL INPUT/OUTPUT SIGNAL VARIATIONS

2.7.1 Objective

The objective was to determine the operational characteristics of data channel when subjected to variations in input signal levels and frequency.

2.7.2 Criteria (EL-CP0138-0001A)

a. The input channels of the TD-1069 shall be capable of detecting and processing balanced input signals at levels from 0.5 to 12 Vp-p. (Para 3.2.6.5)

b. The TD-1069 shall be capable of accepting data streams which have ±0.005 percent frequency tolerance. (Para 3.2.3)

2.7.3 Data Acquisition Procedure

a. Input Signal Level Variations.

(1) The test was set up as shown in figure 9.

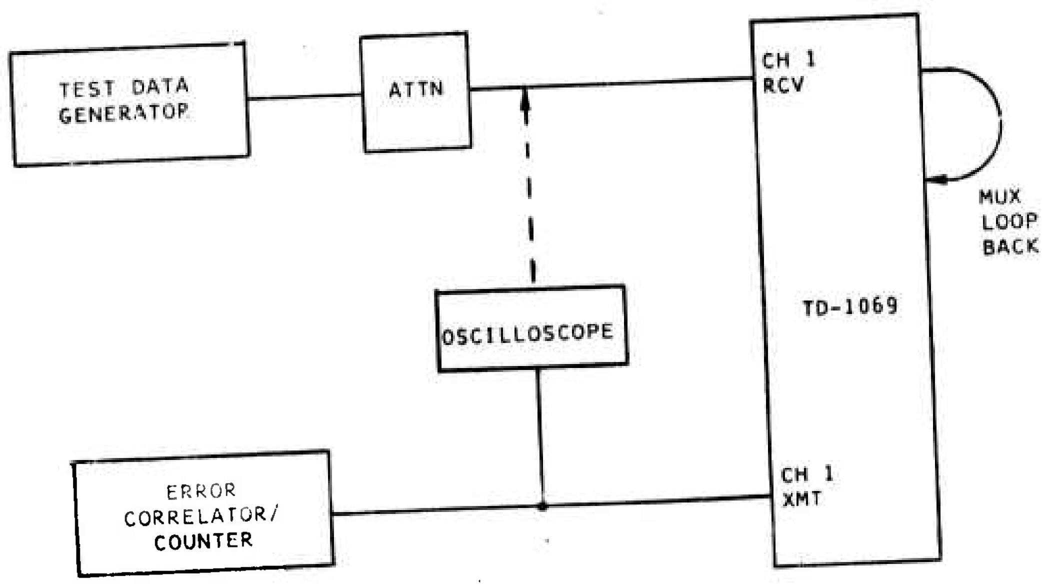

Figure 9. Channel input signal level variations test configuration.

(2) The output of the data generator was set to 600 b/s. The attenuator was adjusted until a 12-Vp-p signal was observed at the input to channel 1.

(3) The output signal levels and ripple were observed on the oscilloscope.

(4) A 5-minute block of test data was transmitted through the channel and the resultant bit errors, if any, were noted.

(5) Steps (1) through (4) above were repeated with the input signal attenuated in 1-Vp-p steps down to 1 Vp-p. Then the input signal level was set at 0.5 Vp-p and steps (1) through (4) were repeated.

(6) Steps (1) through (5) above were repeated using test data rates of 1200, 2400, 4800, and 9600 b/s on channels 5, 10, 15, and 20, respectively, on each item tested.

(7) Steps (1) through (6) were conducted using five test items (SN 10, 16, 20, 21, and 22).

b. Input Signal Data Rate Variations.

(1) The test was set up as shown in figure 9, except that the internal clock rate was varied to provide variations in the data rate of ±50 parts per million (ppm) (equivalent to ±0.005 percent).

(2) Bit error rate (BER) tests were run at each data rate (600, 1200, 2400, 4800, and 9600 b/s) with the basic rate varied by +50 ppm and then -50 ppm.

(3) Resultant bit errors, if any, were noted.

(4) This test was repeated on channel 12 of two items (SN 22 and 24).

2.7.4 <u>Results</u>

There were no bit errors detected during any of the input signal level or data rate variation tests. The output signal levels did not change significantly as the input level was decreased. The ripple on the output signal did not change significantly as the input signal level was decreased.

2.7.5 Analysis

The TD-1069 is not susceptible to variations in either data input voltage level or data rate provided the variations remain within the limits specified in the criteria.

a. The input channel of the TD-1069 was found to be capable of detecting and processing balanced input signals at levels from 0.5 to 12 Vp-p.

b. The TD-1069 was found to be capable of accepting data streams which have ±0.005 percent frequency tolerance.

2.8 CHANNEL SIGNAL CHARACTERISTICS

2.8.1 Objective

The objective was to determine the waveshape and phasing characteristics of the channel signal.

2.8.2 Criteria (EL-CP0138-0001A)

a. The output signal waveshape, when operating in the MIL-STD-188C mode, shall conform to figure 2 of the Development Specification. (Para 3.2.6.8)

b. TTL signals shall be limited to rise and fall times at the interface of 1 microsecond (μsec) or greater. (Para 3.2.6.8)

c. The phase relationship between the TTL data and clock output signals shall be as indicated in figure 4 of the Development Specification. (Para 3.2.6.2)

d. The open circuit output voltage of a channel for balanced transmission shall be positive and negative 6 ±1 volts. Ripple shall be less than 0.5 percent under normal operating conditions. The balance between the positive and negative voltages shall be within 10 percent of each other. (Para 3.2.6.6)

e. For balance TTL transmission, a TD-1069 channel shall be capable of producing voltage levels from 0.0 to +0.4 volt for a logic "0" and from +2.4 to +5.0 volts for logic "1". (Para 3.2.6.6)

2.8.3 Data Acquisition Procedure

a. The test was set up as shown in figure 10.

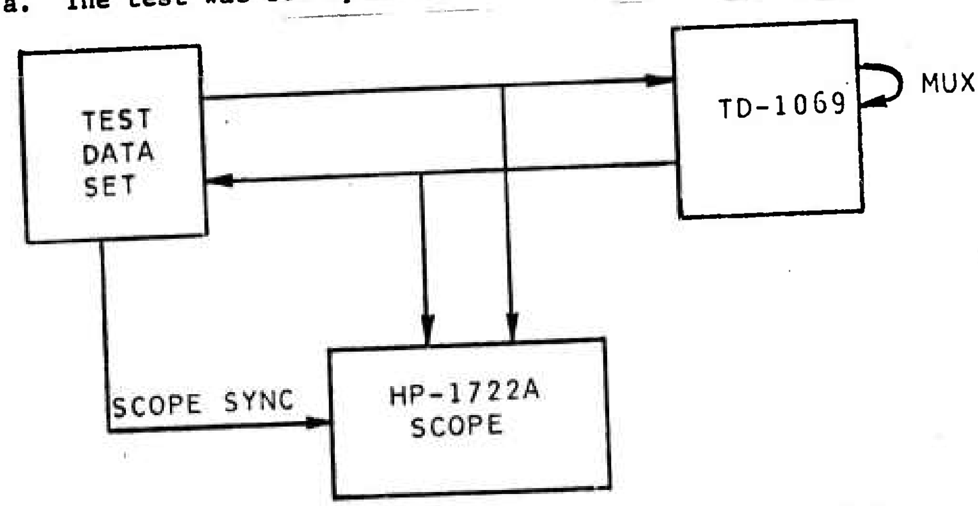

Figure 10. Channel signal characteristics test setup.

b. The test item was set for the MIL-STD mode of operation. Measurements were taken on channels 5 and 10 of the test item at all five (600, 1200, 2400, 4800, and 9600 b/s) data rates.

c. The following parameters were observed on the oscilloscope:

(1) Positive signal level.

(2) Negative signal level.

(3) Ripple (noise).

(4) Signal rise time.

(5) Signal fall time.

(6) Signal repetition rate.

d. The test item was then set for the TTL mode of operation. Measurements were taken on channels 1, 5, 10, 15, and 20 at data rates of 600, 1200, 2400, 4800, and 9600 b/s, respectively.

e. The following parameters were observed on the oscilloscope:

(1) Positive signal level (differential mode).

(2) Negative signal level (differential mode).

(3) "0" voltage level (one side grounded).

(4) "1" voltage level (one side grounded).

(5) Signal rise time.

(6) Signal fall time.

f. All measurements were taken on test item SN 17, except for TTL timing and data phase relationships and TTL rise and fall time measurements which were made on SN 24.

2.8.4 Results

a. Results of the measurements in the MIL-STD mode are shown in table VI.

TABLE VI. CHANNEL SIGNAL CHARACTERISTICS TEST RESULTS, MIL-STD MODE (SN 17)

Data Rate (b/s)	Positive* Signal Level (volts)	Negative* Signal Level (volts)	Rise Time (μsec)	Fall Time (μsec)	Repetition Rate (μsec)	Ripple (Noise) (Vp-p)
			Channel 5			
600	6.36	6.78	2.9	3.2	1668	0.14
1200	6.38	6.80	2.9	3.0	833	0.18
2400	6.34	6.80	2.8	3.0	416	0.14
4800	6.35	6.82	2.85	2.7	208.6	0.18
9600	6.37	6.83	2.75	2.85	104.2	0.15
			Channel 10			
600	6.53	6.96	3.0	2.8	1668	
1200	6.55	6.98	2.7	2.8	833	
2400	6.58	6.94	2.9	2.85	416	
4800	6.48	7.03	2.76	2.75	208.5	
9600	6.48	7.00	2.66	2.80	104.1	

*Open circuit voltage

b. Results of the measurements in the TTL mode are shown in table VII.

TABLE VII. CHANNEL SIGNAL CHARACTERISTICS TEST RESULTS, TTL MODE (SN 24)

		Differential		One Side Grounded			
Data Rate (b/s)	Channel	Positive Signal Level (volts)	Negative Signal Level (volts)	"0" Voltage Level (mV)	"1" Voltage Level (volts)	Signal Rise Time (μsec)	Signal Fall Time (μsec)
600	1	1.77	1.76	+72	+2.26	1.0	0.70
1200	5	1.72	1.74	+80	+2.25	0.45	0.75
2400	10	1.65	1.78	+70	+2.19	0.55	0.45
4800	15	1.71	1.78	+62	+2.24	0.58	0.50
9600	20	1.69	1.77	+66	+2.24	0.68	0.57

c. The phase relationship between the TTL timing and data signals at the leading edge of the data was as follows: The timing signal was leading the data signal by approximately 0.2 μsec. At the trailing edge of the data, the data (trailing edge) was leading the timing pulse by approximately 0.1 μsec. The phase relationships were found to be approximately the same at all data rates.

2.8.5 Analysis

The waveshape, signal amplitudes, rise and fall times, and ripple of both the MIL-STD and TTL data signals conformed to the specification. The phase relationship between the TTL timing and data signals also met the specified requirement. The TTL logic "1" voltage level was found to be approximately +2.2 Vdc. There was no evidence of any degradation of performance as a result of this noncompliance.

2.9 CHANNEL LOADING

2.9.1 Objective

The objective was to determine the operational characteristics of the test item when processing a full load of data traffic.

2.9.2 Criteria (EL-CP0138-0001A, para 3.2.4)

The TD-1069 shall provide for multiple channel access. The total input rate allocated (30 kilobits per second (kb/s)) shall be utilized to the fullest extent possible to provide a high degree of flexibility in the number of input channel configurations. The following channel configurations are required:

a. Up to 24 channels of 600 b/s.

b. Up to 24 channels of 1200 b/s.

c. A 16-channel configuration of 9 channels at 2400 b/s and 7 channels at 1200 b/s.

2.9.3 Data Acquisition Procedure

a. The test was initially set up as shown in figure 2.

b. The items tested, SN 22 to 24, were initially set up for 24 channels of data at 600 b/s. Two data sources were connected to two ports and BER tests were run as described in paragraph 2.4.3.

c. Additional data sources were added by looping data streams from one channel to the next and BER tests were run to determine if there was any degradation in performance as the traffic load increased. Also, one idle channel port was monitored with an oscilloscope and true rms voltmeter to determine the characteristics of any noise that was present.

d. This procedure was continued until a full load (24 channels of 600 b/s data) was applied to the test item.

e. The procedure above (paras a through d) was repeated for the following full load conditions:

(1) 24 channels of 1200 b/s.

(2) 9 channels of 2400 b/s and 7 channels of 1200 b/s.

(3) 12 channels of 2400 b/s and 1 channel of 1200 b/s.

(4) 6 channels of 9600 b/s and 1 channel of 1200 b/s.

2.9.4 Results

There were no bit errors detected during any of the testing. The idle channel noise (60 mVrms) did not increase as the channel loading was increased.

2.9.5 Analysis

There was no detectable change in performance as the channel loading was increased. Performance was satisfactory under maximum loading. The TD-1069 met the criteria.

2.10 CHANNEL PHASE JITTER

2.10.1 Objective

The objective was to determine the phase jitter characteristics of the data channel.

2.10.2 Criterion

None.

2.10.3 Data Acquisition Procedure

a. The test was set up as shown in figure 10.

b. The test item was set for the MIL-STD mode of operation. The jitter was observed on the oscilloscope.

c. Measurements were taken on channels 23, 24, 1, 2, and 3 at rates of 600, 1200, 2400, 4800, and 9600 b/s, respectively. Measurements were taken on two items (SN 09 and 24).

2.10.4 Results

The results of the phase jitter measurements are shown in table VIII.

TABLE VIII. CHANNEL PHASE JITTER TEST RESULTS

Data Rate (b/s)	Channel	SN 09 Jitter (μsec)	SN 24 Jitter (μsec)
600	23	100	100
1200	24	50	50
2400	1	30	30
4800	2	20	20
9600	3	20	20

2.10.5 Analysis

The jitter shown above is characterized by slow drifting with an oscillation of about 2 to 3 seconds in duration. The measurements were taken by observing the oscilloscope for a few seconds and noting the maximum excursions.

2.11 CHANNEL PHASE DELAY

2.11.1 Objective

The objective was to determine the phase delay characterisitcs of the data channel.

2.11.2 Criterion

None.

2.11.3 Data Acquisition Procedure

a. The test was set up as shown in figure 10.

b. The test item was set for MIL-STD mode of operation. The phase delay was observed on the oscilloscope.

c. Measurements were taken in channels 23, 24, 1, 2, and 3 at data rates of 600, 1200, 2400, 4800, and 9600 b/s, respectively. Measurements were taken on two items (SN 09 and 24).

2.11.4 Results

The results of the phase delay measurements are shown in table IX.

TABLE IX. CHANNEL PHASE DELAY TEST RESULTS

Data Rate (b/s)	Channel	SN 09 Phase Delay (msec)	SN 24 Phase Delay (msec)
600	23	14.8	14.6
1200	24	7.8	7.8
2400	1	4.0	3.9
4800	2	2.0	1.9
9600	3	0.98	1.0

2.11.5 Analysis

None.

2.12 MULTIPLEXER IMPEDANCE

2.12.1 Objective

The objective was to determine the impedance of the multiplexer input/output ports.

2.12.2 Criteria (EL-CP0138-0001A)

a. The input impedance of the TD-1069 demultiplexer section shall be 600 ohms (±10 percent).

b. The output impedance of the TD-1069 multiplexer ports shall be 600 ohms (±10 percent).

2.12.3 Data Acquisition Procedure

a. The test was set up as shown in figure 5 except that the data generator output was connected to the MUX IN ports of the test item.

b. The procedure as described in paragraph 2.5.3a was followed except that the rate generator was set to 32 kilohertz (kHz) and the output of the data generator was set to maximum (approximately 4 Vp-p).

c. The test was then set up as shown in figure 6 except that the data generator was connected to the MUX IN ports and the true rms voltmeter and switch S-1 were connected to the MUX OUT ports of the test item.

d. The procedure as described in paragraph 2.5.3b was followed except that the rate generator output was set to 32 kHz and the output of the data generator was set to maximum (approximately 4 Vp-p).

2.12.4 Results

Results of the test are tabulated in table X.

TABLE X. MULTIPLEXER IMPEDANCE TEST RESULTS

Test Item SN	Input Impedance (ohms)	Output Impedance (ohms)
10	543	519
16	544	517
20	546	524
21	545	525
22	547	515

2.12.5 Analysis

The average impedance for the MUX input ports was 545 ohms and for the MUX output ports was 520 ohms. The MUX output impedance did not meet the specified requirement of "600 ohms (±10 percent)," however, longitudinal balance (para 2.13) and operation over 3 miles of field wire/cable (para 2.18) requirements were met. It is concluded that the impedance noncompliance does not degrade system performance.

2.13 MULTIPLEXER LONGITUDINAL BALANCE

2.13.1 Objective

The objective was to determine the longitudinal balance of the multiplexer input/output ports.

2.13.2 Criteria (EL-CP0138-0001A)

a. The longitudinal balance of the MUX input pair shall not be less than 40 dB. (Para 3.2.8.3.1)

b. The longitudinal balance of the MUX output pair shall not be less than 40 dB. (Para 3.2.7.4.1)

2.13.3 Data Acquisition Procedure

a. The test was set up as shown in figure 7 except that points A and B were connected to the MUX input ports of the test item.

b. The signal generator output was set to 32 kHz. The signal level was set to 6 Vp-p.

c. The procedures of paragraph 2.6.3a were then followed.

d. The test was set up as shown in figure 8 except that the test circuit was connected to the MUX output ports.

e. The procedures of paragraph 2.6.3b were then followed.

2.13.4 Results

Results of the test are shown in table XI.

TABLE XI. MULTIPLEXER LONGITUDINAL BALANCE TEST RESULTS

Test Item SN	Input Ports (dB)	Output Ports (dB)
10	52.3	71.4
16	54.1	71.4
20	47.8	65.6
21	51.5	45.5
22	48.1	71.3

2.13.5 Analysis

The average longitudinal balance for the MUX input ports was 51 dB and for the MUX output ports was 65 dB. These meet the specified requirements of "not less than 40 dB."

2.14 MULTIPLEXER INPUT/OUTPUT SIGNAL LEVELS

2.14.1 Objective

The objective was to determine the operational characteristics of the test item when subjected to variations in the multiplexer input signal level.

2.14.2 Criteria (EL-CP0138-0001A)

a. The TD-1069 shall be capable of detecting and processing a multiplexer input signal whose level may range from 0.1 to 6.0 Vp-p. (Para 3.2.8.3)

b. The TD-1069 shall provide a multiplexer output with transmission voltage levels of either 6 or 1 Vp-p ±10 percent when terminated in 600 ohms (±10 percent). The output levels shall be switch selectable. (Para 3.2.7.4)

2.14.3 Data Acquisition Procedure

a. The test was set up as shown in figure 11. One data generator was connected to channel 1 and set to 4800 b/s. The other was connected to channel 15 and set to 9600 b/s.

b. The output from the attenuator was initially set to 6 Vp-p as observed on the oscilloscope. A 5-minute block of test data was transmitted through both data channels (1 and 15) and the resultant bit errors, if any, were noted.

c. Step b above was repeated with the input to the MUX input ports decreased in 1-Vp-p increments down to 1 Vp-p; then in 0.2-Vp-p increments down to 0.2 Vp-p.

d. The lower threshold at which errors occur was also determined.

e. Correct operation of the output level HIGH/LOW switch was verified by observing the oscilloscope and operating the switch.

2.14.4 Results

None of the five items tested (SN 10, 16, 20, 21, and 22) experienced any bit errors down to input signal levels of 0.2 Vp-p. Errors did occur before a signal level of 0.1 Vp-p was reached. The threshold voltage level at which errors occurred was found to be as follows:

Test Item SN	Threshold (Vp-p)
10	0.170
16	0.150
20	0.170
21	0.160
22	0.140

The output signal level HIGH/LOW switch operated correctly.

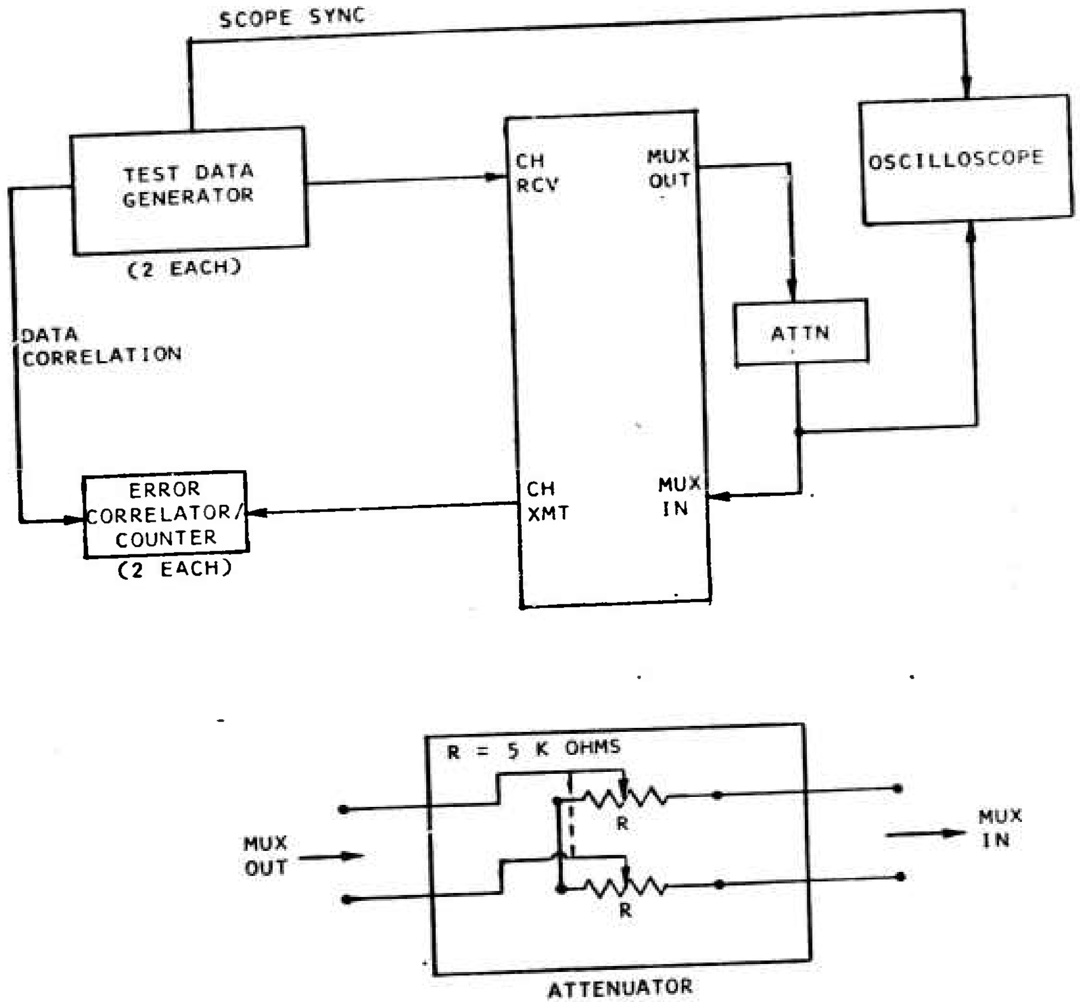

Figure 11. MUX input/output signal levels test setup.

2.14.5 Analysis

a. The test item was not capable of detecting and processing signal levels below approximately 0.2 Vp-p. However, the requirement for operation over 3 miles of field wire was met. It is concluded that this noncompliance does not degrade system performance.

b. The output voltage levels were measured during subtest 2.15, and were found to be within limits. The output level switch was found to work properly.

2.15 MULTIPLEXER SIGNAL CHARACTERISTICS

2.15.1 Objective

The objective was to determine the waveshape characteristics of the multiplexer output signals.

2.15.2 Criteria (EL-CP0138-0001A)

a. The output data rate of the TD-1069 shall be 32.0 kb/s. The output shall have a frequency accuracy of ±0.001 percent at room ambient temperature. (Para 3.2.7.1)

b. The transmission format of the TD-1069 output bit stream shall be conditioned diphase. The output waveshape shall conform to figure 2 of the Development Specification. (Para 3.2.7.2)

2.15.3 Data Acquisition Procedure

a. The test will be set up as shown in figure 12.

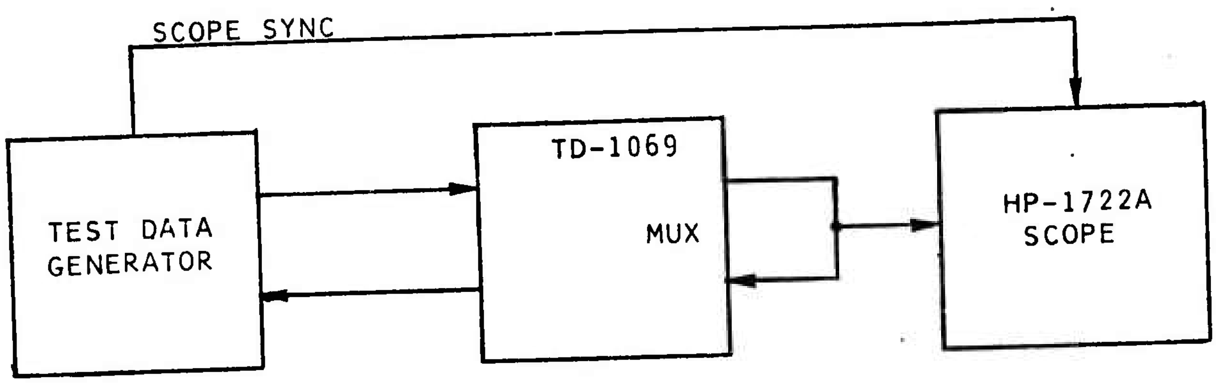

Figure 12. MUX signal characteristics test setup.

b. The MUX signal was observed on the oscilloscope and the following parameters were noted:

(1) Positive signal level (6-volt mode).

(2) Negative signal level (6-volt mode).

(3) Signal rise time.

(4) Signal fall time.

(5) Ripple (noise).

(6) Positive signal level (1-volt mode).

(7) Negative signal level (1-volt mode).

c. Measurements were made on three test items (SN 17, 21, and 22).

d. MUX signal pulse with data rate was measured on test items (SN 22 and 24).

2.15.4 Results

The results of the test are shown in table XII.

TABLE XII. MULTIPLEXER SIGNAL CHARACTERISTICS TEST RESULTS

	6-Volt Mode					1-Volt Mode	
Test Item SN	Positive Signal Level (volts)	Negative Signal Level (volts)	Rise Time (μsec)	Fall Time (μsec)	Ripple (Noise) (mW)	Positive Signal Level (volts)	Negative Signal Level (volts)
17	3.30	3.37	4.8	4.79	77	0.56	0.56
21	3.49	3.56	4.65	4.79	78	0.58	0.59
22	3.44	3.53	4.74	4.73	85	0.58	0.59

	MUX Signal Pulse Width (msec)	Equivalent Data Rate (b/s)
22	15.6	32.051
24	15.5	32.250

2.15.5 Analysis

The waveshape characteristics of the MUX signal conformed to the specification.

a. The output data rate meets the criteria within the limits of instrumentation accuracy.

b. Data format and waveshape conforms to the criteria.

2.16 MULTIPLEXER PERFORMANCE IN THE PRESENCE OF NOISE

2.16.1 Objective

The objective was to determine the performance characteristics (S/N vs BER) of the multiplexer channel when noise is injected into the data stream.

2.16.2 Criterion

None.

2.16.3 Data Acquisition Procedure

a. The test was set up as shown in figure 13.

b. The output of the data generator was set to 9.6 kb/s in the MIL-STD mode and connected to channel 12.

c. The output of the noise generator was set to maximum and the attenuation was set to maximum (110 dB) to provide minimum noise into the channel. The signal-to-ground voltage (V_1) as indicated on the true rms voltmeter was recorded.

d. The attenuation was then decreased to 0 dB to provide maximum noise into the channel and the resultant signal-plus-noise-to-ground voltage (V_2) was recorded. A 5-minute block of digital test data was transmitted through the TD-1069's and resultant errors, if any, were noted.

e. Step d above was repeated with the attenuation set to 4 dB, then 8 dB, and then 20 dB.

f. The procedure above (steps a through e) was repeated at data rates of 600, 1200, 2400, and 4800 b/s.

g. The entire procedure was repeated using channel 6 in the TTL mode of operation.

2.16.4 Results

Test results are shown in table XIII.

2.16.5 Analysis

The test data indicates that the TD-1069 is not susceptible to common mode noise interjected into the transmission link since there were no bit errors detected during any of the testing.

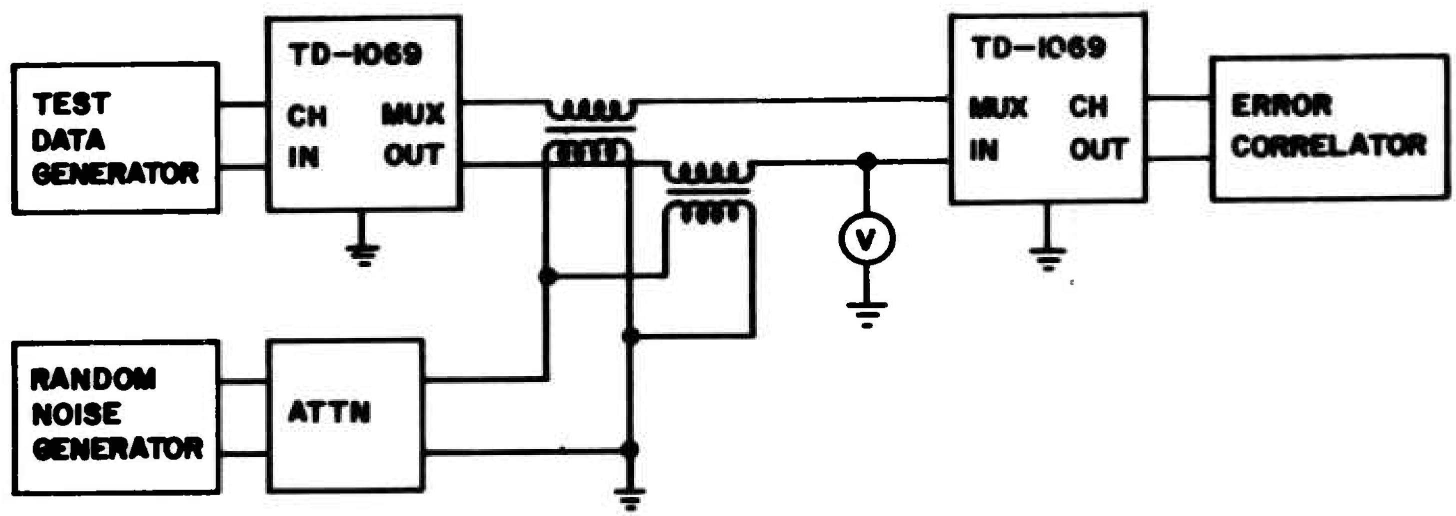

Figure 13. Multiplexer performance in the presence of noise test setup.

TABLE XIII. MUX PERFORMANCE IN THE PRESENCE OF NOISE TEST RESULTS

Data Rate (b/s)	Noise Attn (dB)	Signal Plus Noise Level (Vrms)	Noise Level (Vrms)	S/N (dB)	Error Count MIL-STD	Error Count TTL
600	110	1.35	0	Max	0	0
600	20	1.40	0.37	11.2	0	0
600	8	1.50	0.65	6.4	0	0
600	4	1.60	0.86	3.9	0	0
600	0	1.74	1.08	1.9	0	0
1200	110	1.35	0	Max	0	0
1200	20	1.40	0.37	11.2	0	0
1200	8	1.50	0.65	6.4	0	0
1200	4	1.60	0.86	3.9	0	0
1200	0	1.74	1.08	1.9	0	0
2400	110	1.35	0	Max	0	0
2400	20	1.40	0.37	11.2	0	0
2400	8	1.50	0.65	6.4	0	0
2400	4	1.60	0.86	3.9	0	0
2400	0	1.74	1.08	1.9	0	0
4800	110	1.35	0	Max	0	0
4800	20	1.40	0.37	11.2	0	0
4800	8	1.50	0.65	6.4	0	0
4800	4	1.60	0.86	3.9	0	0
4800	0	1.74	1.08	1.9	0	0
9600	110	1.35	0	Max	0	0
9600	20	1.40	0.37	11.2	0	0
9600	8	1.50	0.65	6.4	0	0
9600	4	1.60	0.86	3.9	0	0
9600	0	1.74	1.08	1.9	0	0

2.17 SYNCHRONIZATION AND BIT COUNT INTEGRITY

2.17.1 Objective

The objective was to determine the synchronization time and bit count integrity (BCI) characteristics of the test item.

2.17.2 Criteria (EL-CP0138-0001A)

a. The TD-1069 shall acquire synchronization and BCI on a channel within 400 milliseconds (msec) 80 percent of the time following application of a signal to the input of the receiver section. (Approved Waiver No. 6A)

b. The TD-1069 shall be capable of maintaining absolute BCI on a channel basis for a period of 24 hours in a random error environment of 1 error in 10^3 bits at a confidence level of 99 percent. (Para 3.3.1.1)

2.17.3 Data Acquisition Procedure

a. The synchronization/BCI acquisition time was measured as part of a daily operational check during the reliability test (para 2.42). The test configuration was as shown in figure 4. The time differential between application of a test signal and acquisition of synchronization/BCI was determined by activating the synchronization/BCI acquisition mode on the ECOM test set. The time in msec was displayed directly on the test set.

b. The long term BCI was measured during the systems capability test (para 2.21). The BCI was determined by continuously monitoring the BER. An evaluation was made on each error burst to determine whether all twelve voice-band channels were affected or whether only one channel was involved. Any error burst that could be attributed to a transmission disturbance not chargeable to system performance (e.g., power outage) was not counted as a loss of BCI.

c. A mathematical analysis was conducted to determine the statistical limits on the synchronization/BCI acquisition time and maintenance of BCI.

2.17.4 Results

a. Results of the synchronization/BCI acquisition time tests are shown in table XIV.

b. Results of the long term BCI tests are shown in table XVII. A dropout is equivalent to a loss of BCI.

2.17.5 Analysis

a. Assuming a normal distribution of times to acquire BCI, the following computations were made:

Sample mean: 256.3 msec
Sample standard deviation: 141.4 msec
Point estimate probability of $\leq$ 400 msec: $\frac{143}{167} = 0.86$

There is 95 percent confidence that 80 percent of the time BCI will be acquired in $\leq$ 398 msec (Table A7, ref 28, app E).

b. Phase I

The mean-time-between-total dropouts was $\frac{321}{96} = 3.3$ hours.

Phase II

The mean-time-between-total dropouts was $\frac{130}{2} = 65$ hours.

c. If the total dropout rate is assumed to be constant (implying an exponential distribution), then the point estimate probability of accomplishing a 24-hour mission with no total dropouts is:

Phase I

$$P(24 \text{ hours}) = \exp\left(\frac{-24}{3.3}\right) = 0.0007$$

Phase II

$$P(24 \text{ hours}) - \exp\left(\frac{-24}{65}\right) = 0.69$$

d. The test item met the criterion for acquiring BCI in $\leq$ 400 msec.

TABLE XIV. BIT COUNT INTEGRITY ACQUISITION TIME

SN 9 (msec)	SN 9 (msec)	SN 12 (msec)	SN 12 (msec)	SN 13 (msec)	SN 16 (msec)	SN 16 (msec)	SN 24 (msec)	SN 24 (msec)
380	403*	351	204	290	256	203	316	295
202	205	213	403*	37	302	216	35	456*
243	309	24	15	203	30	125	440*	255
326	191	224	205	205	205	204	13	24
422*	18	812*	205	261	203	401*	590*	290
56	432*	336	345		200	217	197	399
202	202	203	218		421*	12	68	429*
15	422*	296	316		318	203	206	293
210	265	466*	206		41	204	203	199
204	215	410*	210		200	312	25	175
13	370	202	208		205	398	210	400
419*	759*	410*	319		391	237	341	199
284	119	30	499*		192		322	801*
401*	205	380	315		318		122	52
210	203	173	210		210		203	203
203	205	269	384		310		194	339
359	54	205	396		202		189	
195		370			366		591*	
18		394			188		45	
207		351			417*		195	
399		207			203		396	
208		204			202		205	
202		423*			204		196	
229		205			34		205	
202		384			428*		206	

Note: Total Readings = 167.
*24 exceed 400 msec (14.4 percent).

2.18 COMPATIBILITY WITH FIELD WIRE AND CABLE

2.18.1 Objective

The objective was to determine the maximum distance effective communications can be established between two TD-1069's when interconnected by field wire and field cable.

2.18.2 Criteria (EL-CP0138-0001A, para 3.2)

The multiplexer section of the TD-1069 shall be capable of interfacing with a demultiplexer section via wire line transmission paths which may consist of up to 3 miles of WF-16 and up to 1000 feet of WM-130.

2.18.3 Data Acquisition Procedure

a. The test will be set up as shown in figure 2 except that the TD-1069's will be interconnected via field wire/field cable. The output of the data generator was set to 9600 b/s.

b. A 1-mile segment of WF-16 field wire was inserted between the TD-1069's. A 5-minute block of test data was transmitted through the equipment and the resultant errors, if any, were noted.

c. The procedure described in paragraphs a and b above was repeated with 1-mile segments of WF-16 added until 4 miles of WF-16 was reached.

d. The procedure above (para b) was repeated using 1000-foot segments (four 250-foot assemblies) of CX-4566 until 5250 feet was reached.

e. The procedure above (para b) was repeated with combinations of WF-16 and CX-4566 as follows:

(1) One mile of WF-16 and 2000 feet of CX-4566.

(2) One mile of WF-16 and 3000 feet of CX-4566.

(3) Two miles of WF-16 and 1000 feet of CX-4566.

(4) Two miles of WF-16 and 2000 feet of CX-4566.

(5) Three miles of WF-16 and 1000 feet of CX-4566.

f. The procedure above (paras a through e) was repeated using WD-1 field wire in place of the WF-16.

g. Subscriber loops were simulated as shown in figure 14. The test described in paragraphs a through f above was repeated.

h. The entire procedure was repeated using two test items (SN 10 and 16).

2.18.4 Results

a. The maximum separation between MUX input and output ports using WF-16 was 4 miles (dry conditions) and 3 miles (wet conditions) for error free transmission. All other configurations tested (as listed in paragraphs 2.18.3d and e) provided error free transmission.

b. The maximum separation between channel input and output ports using WF-16 (dry conditions) was 5 miles for error free transmission. All other configurations tested (as listed in paragraph 2.18.3d and e) provided error free transmission.

c. Test results using WD-1 in place of the WF-16 were the same as described in paragraphs a and b above.

2.18.5 Analysis

The test item met or exceeded the criteria during each portion of the subtest.

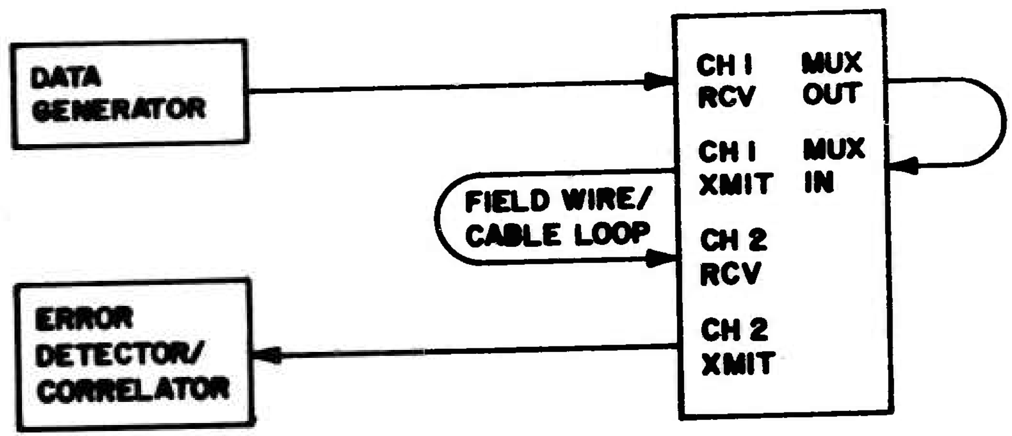

Figure 14. Subscriber loop simulation test setup.

2.19 COMPATIBILITY WITH TACTICAL TELETYPE

2.19.1 Objective

The objective was to determine the operational characteristics of the test item when processing teletype (TTY) traffic.

2.19.2 Criteria (EL-CP0138-0001A, para 3.2.5)

a. For TTY traffic, a 1200-b/s channel shall be enabled to accept and produce low level balanced TTY transmission at speeds as follows:

(1) ASCII 10.0 unit start-stop at 75.0 and 150.0 b/s.

(2) BAUDOT 7.0 unit start-stop at 45.50 ±0.09, 50.0, and 75.0 b/s.

(3) BAUDOT 8.0 unit start-stop at 45.50 ±0.09, 50.0, and 75.0 b/s.

b. TTY signal speeds shall be within ±5 percent of the rates specified in paragraph a above except as indicated and shall have less than 5 percent bias distortion.

c. The receive section of the TD-1069 shall demultiplex TTY signals with less than 20 percent mark to space, bias, or end distortion.

2.19.3 Data Acquisition Procedure

a. The test was set up as shown in figure 15.

b. TTY messages in the following format and speeds were transmitted through the TD-1069's:

(1) ASCII 10.0 unit start-stop at 75 b/s.

(2) ASCII 10.0 unit start-stop at 150 b/s.

(3) BAUDOT 7.0 unit start-stop at 45.5 b/s.

(4) BAUDOT 7.0 unit start-stop at 50 b/s.

(5) BAUDOT 7.0 unit start-stop at 75 b/s.

(6) BAUDOT 8.0 unit start-stop at 45.5 b/s.

(7) BAUDOT 8.0 unit start-stop at 50 b/s.

(8) BAUDOT 8.0 unit start-stop at 75 b/s.

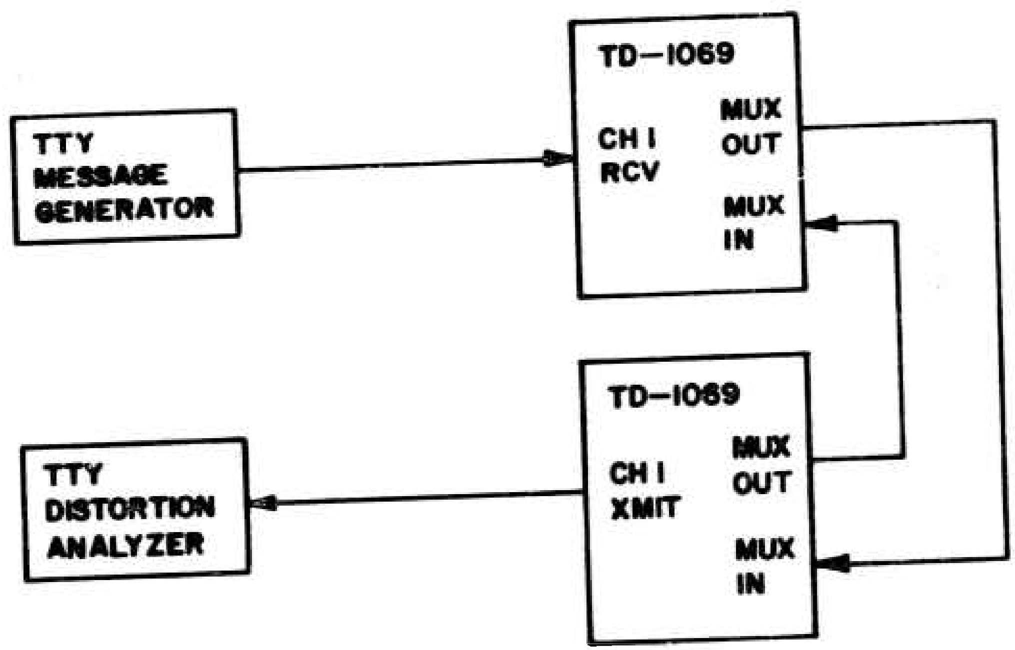

Figure 15. TTY compatibility test setup.

c. The end, bias, and total distortion at the receive end of the link was recorded for each message transmitted.

d. The test (para b above) was initially run with zero distortion in the TTY messages. The test was repeated with 5 percent marking bias, 5 percent spacing bias, and 5 percent switched bias distortion added to each message.

e. Compatibility tests were also conducted between the TD-1069 and Forward Area Tactical TTY AN/UGC-75 during the systems test (para 2.21). "Quick-brown-fox" test messages were transmitted through the various system configurations (one per hour) and the receive copy was checked for errors.

2.19.4 Results

Test results are shown in tables XV and XVI.

TABLE XV. COMPATIBILITY WITH TTY TEST RESULTS, ASCII 10.0 UNIT START-STOP

Input Signal Distortion (%)	Output Signal Distortion (%)					
	75 Baud Rate			150 Baud Rate		
	End	Bias	Total	End	Bias	Total
0	2-1/4	2-1/2	2-1/2	9	9	9-1/2
5 Spacing	2	7-3/4	7-3/4	9-1/2	10-3/4	10-1/2
5 Marking	2-1/4	7-1/2	7-1/2	9-1/2	11	11
5 Switching	2-1/4	7-1/2	7-1/2	7	11	11

TABLE XVI. COMPATIBILITY WITH TTY TEST RESULTS, BAUDOT

Input Signal Distortion (%)	Output Signal Distortion (%)								
	45.5 Baud Rate			50 Baud Rate			75 Baud Rate		
	End	Bias	Total	End	Bias	Total	End	Bias	Total
7.0 Unit Start-Stop									
0	1/2	1	1	0	0	0	3	3	3-1/2
5 Spacing	1	5-1/2	5-1/2	0	3-1/2	7	3	7-1/2	7-1/2
5 Marking	1/2	6	6	0	3-1/2	7	3	8	8
5 Switching	10	6	10	11	7	11	11	7-1/2	12
8.0 Unit Start-Stop									
0	0	1	1-1/2	0	0	1	2	2	3-1/2
5 Spacing	1	5-1/2	5-1/2	0	6-1/2	6-1/2	3	7-1/2	7-1/2
5 Marking	1/2	5-1/2	5-1/2	0	6-1/2	6-1/2	3	7-1/2	7-1/2
5 Switching	1/2	5-1/2	5-1/2	0	6-1/2	6-1/2	3	8	8

2.19.5 Analysis

The maximum output distortion found during the test was 12 percent. The TD-1069 meets the requirement of not more than 20 percent output distortion. There were no compatibility problems found during the systems test between the AN/UGC-75 and the TD-1069. All transmissions were error free.

2.20 COMPATIBILITY WITH THE TD-1065

2.20.1 Objective

The objective was to determine the operational characteristics of the test item when interconnected via the TD-1065 data buffer.

2.20.2 Criterion (EL-CP0138-0001A, para 3.1)

The TD-1069 shall provide a digital data transmission capability when used in conjunction with the TD-1065.

2.20.3 Data Acquisition Procedure

This test was conducted in conjunction with the systems test (para 2.21) where the TD-1069 was used as digital subscriber terminal equipment.

2.20.4 Results

There was no evidence of any compatibility problems between the TD-1065 and TD-1069 except for the 1-mile of field wire satisfactory transmission limit encountered during the TD-1065 test program.

2.20.5 Analysis

The field wire limit encountered during the TD-1065 test program is not attributed to the TD-1069 since transmission from a TD-1069 to a TD-1065 was satisfactory; whereas, transmission from a TD-1065 to a TD-1069 was not.

2.21 COMPATIBILITY WITH ATACS TRANSMISSION SYSTEMS

2.21.1 Objective

The objective was to determine if the operational characteristics of the test item are compatible with the various equipments and configurations of the Army Tactical Area Communications Systems (ATACS).

2.21.2 Criteria

a. The TD-1069 shall provide a 24-channel digital data transmission capability when used in communication centers of the ATACS. (EL-CP0138-0001A, para 3.1)

b. Installation of the TD-1069 into ATACS assemblages shall not degrade operation of the associated terminal equipment or the TD-1065. (MN for TD-1069, para VIa(3)(h))

2.21.3 Data Acquisition Procedure

a. Systems test configurations were set up as shown in figures 16 through 23. TD-1065's and TD-1069's were installed in modified ATACS assemblages as indicated below:

Assemblage	TD-1065	TD-1069
Telephone Terminal AN/TCC-61	5	0
Telephone Terminal AN/TCC-65	2	0
Telephone Terminal AN/TCC-69	2	2
Telephone Terminal AN/TCC-72	2	2
Telephone Terminal AN/TCC-73(V)2	5	0
Radio Terminal AN/TRC-117	2	2
Radio Terminal AN/TRC-145	2	2

All voice/data subscriber circuits were connected through a technical control center AN/TSQ-84 to provide a routing and circuit testing capability. Digital subscribers were then connected to the system through the AN/TSQ-84 via 26-pair cable (CX-4566) as shown in figure 24.

b. BER/BCI tests were run on each test configuration in 24-hour blocks except as indicated in table XVII. Test instrumentation and equipment performance were monitored continuously during each test. Teletype "quick-brown fox" messages were transmitted through the system at a rate of one per hour. Received TTY copy was checked for errors.

c. Systems testing was conducted in two phases. Phase I was conducted using the single link configurations shown in figures 16 through 23. All testing was conducted in the 12-channel mode of operation except for Link A testing which was in a 24-channel mode. Channel loading was as shown in figure 24. Phase II was conducted on both single and tandem link configurations. Phase II was initiated after a joint ECOM/USAEPG investigation of the BCI dropout problem revealed during Phase I was completed. Several problem areas identified during the investigation were eliminated or minimized prior to initiation of Phase II. Single channel loading was used during Phase II. Phase II tests were conducted in both 12- and 24-channel modes.

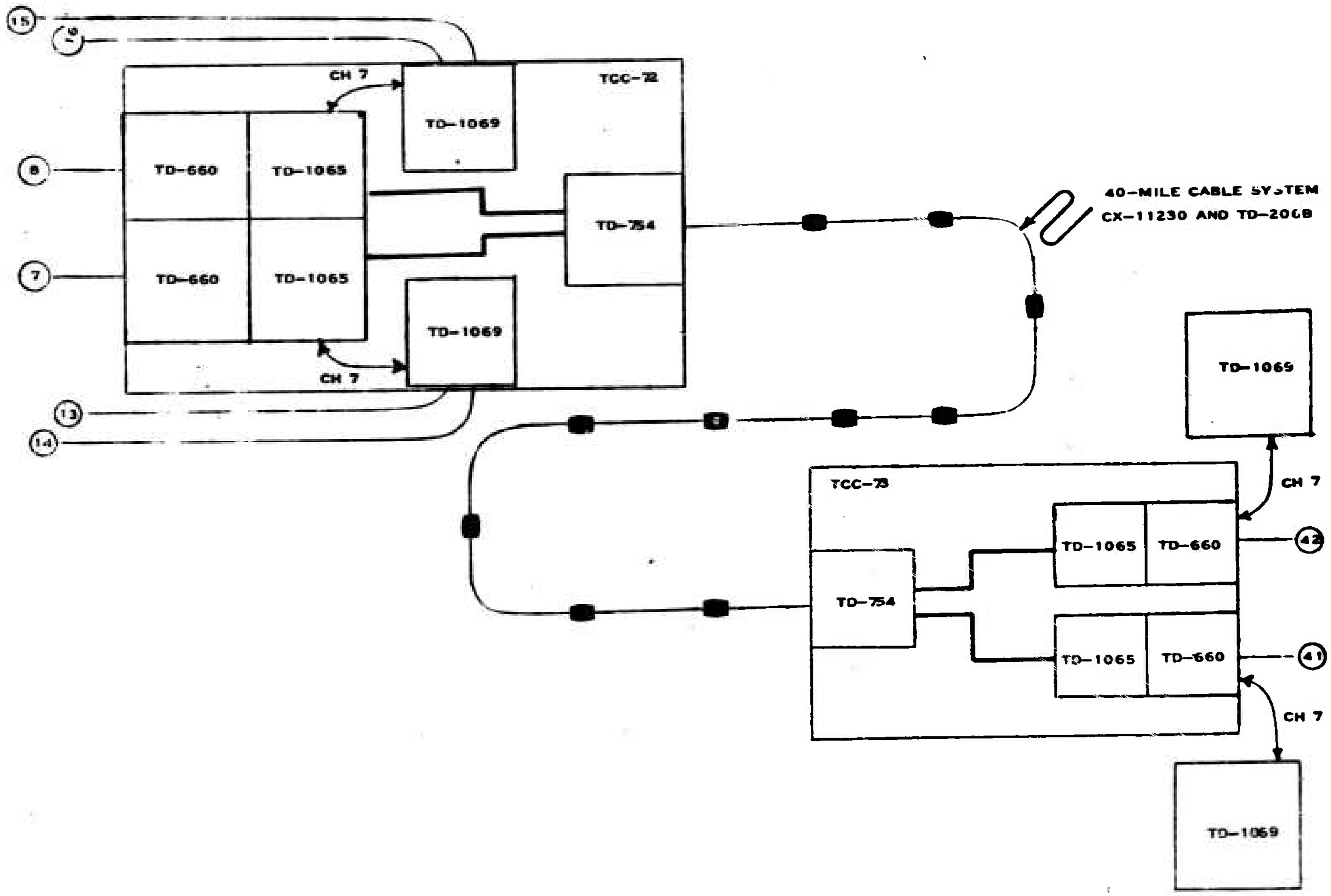

Figure 16. System test configuration (link A).

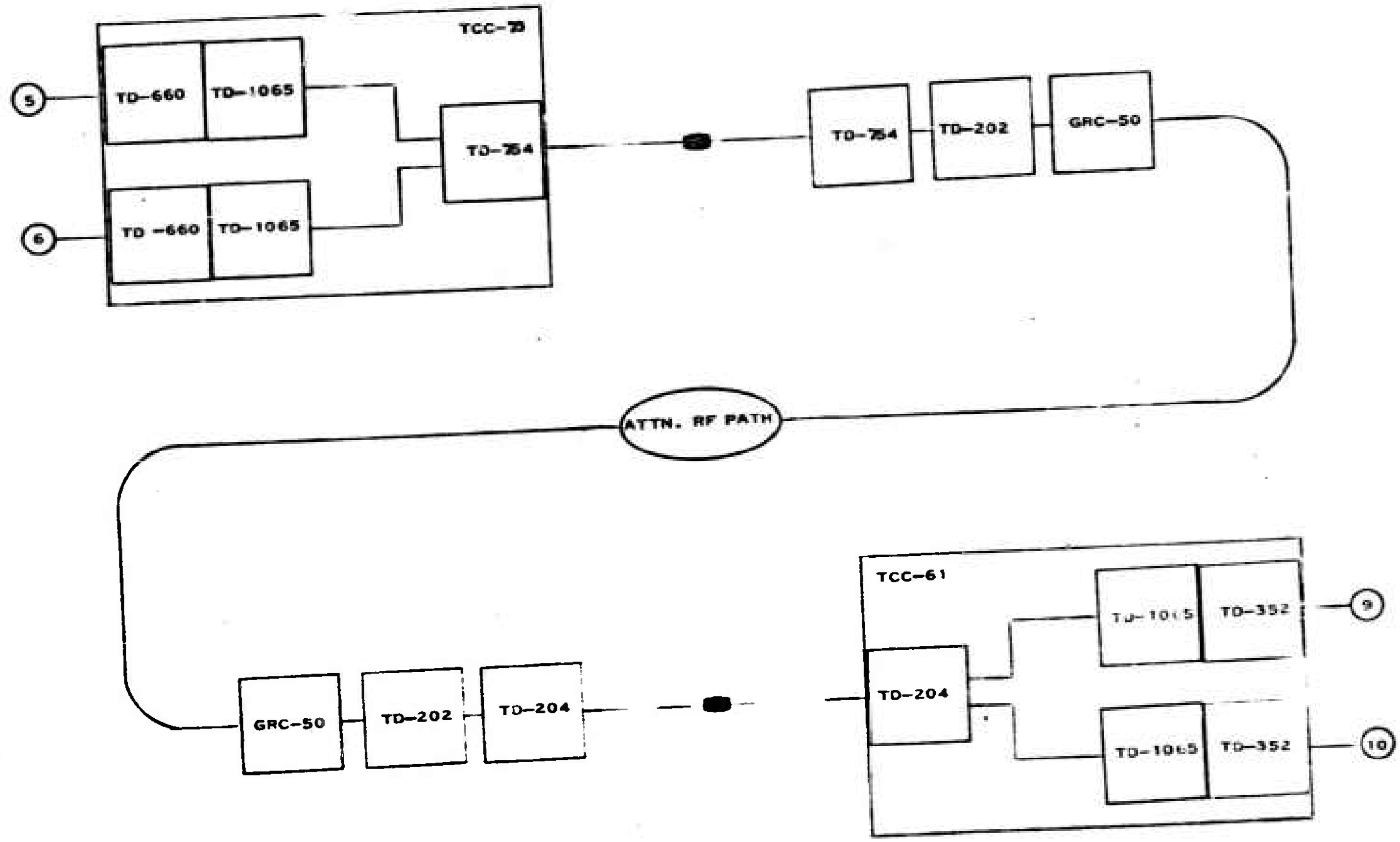

Figure 17. System test configuration (link B).

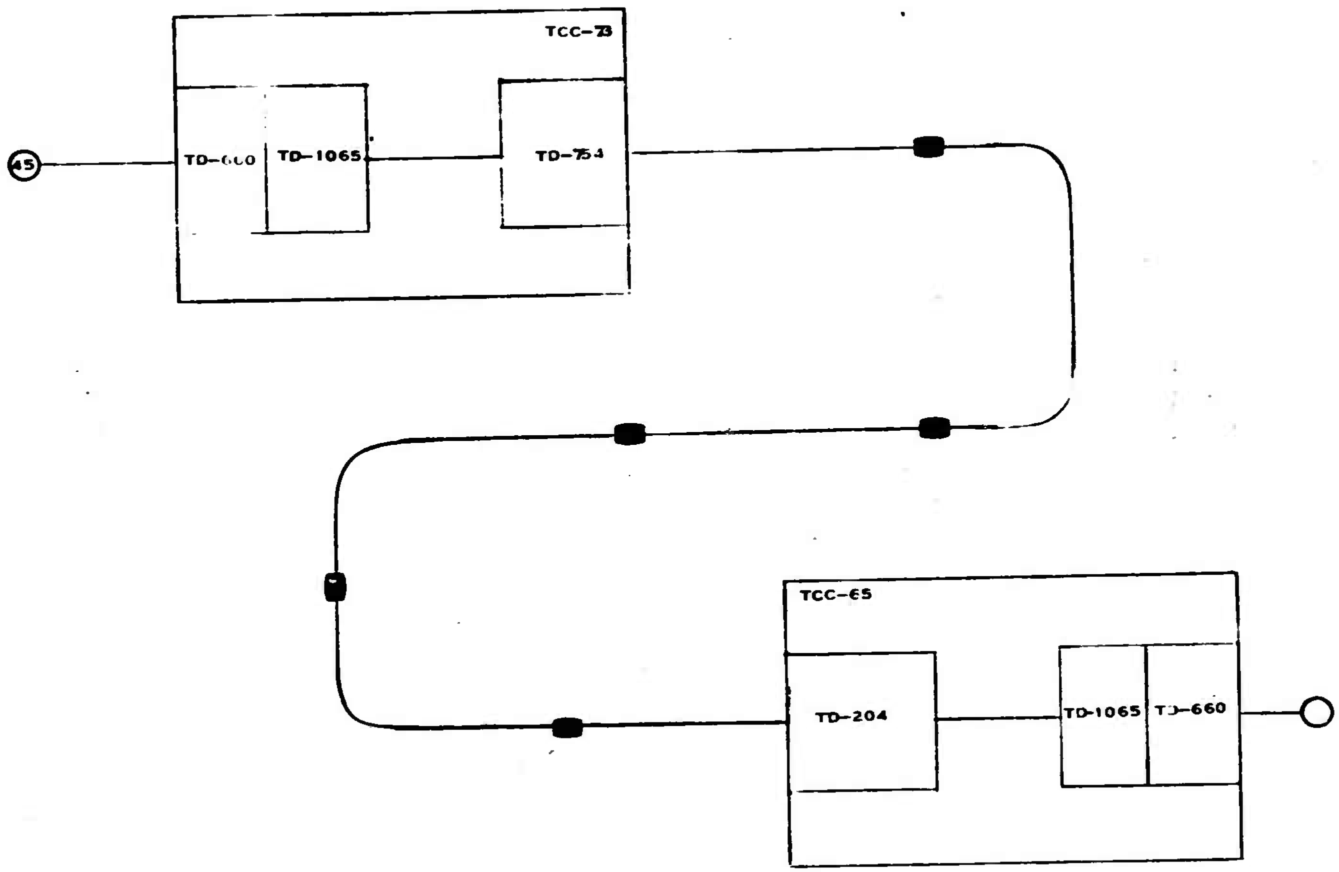

Figure 18. System test configuration (link C).

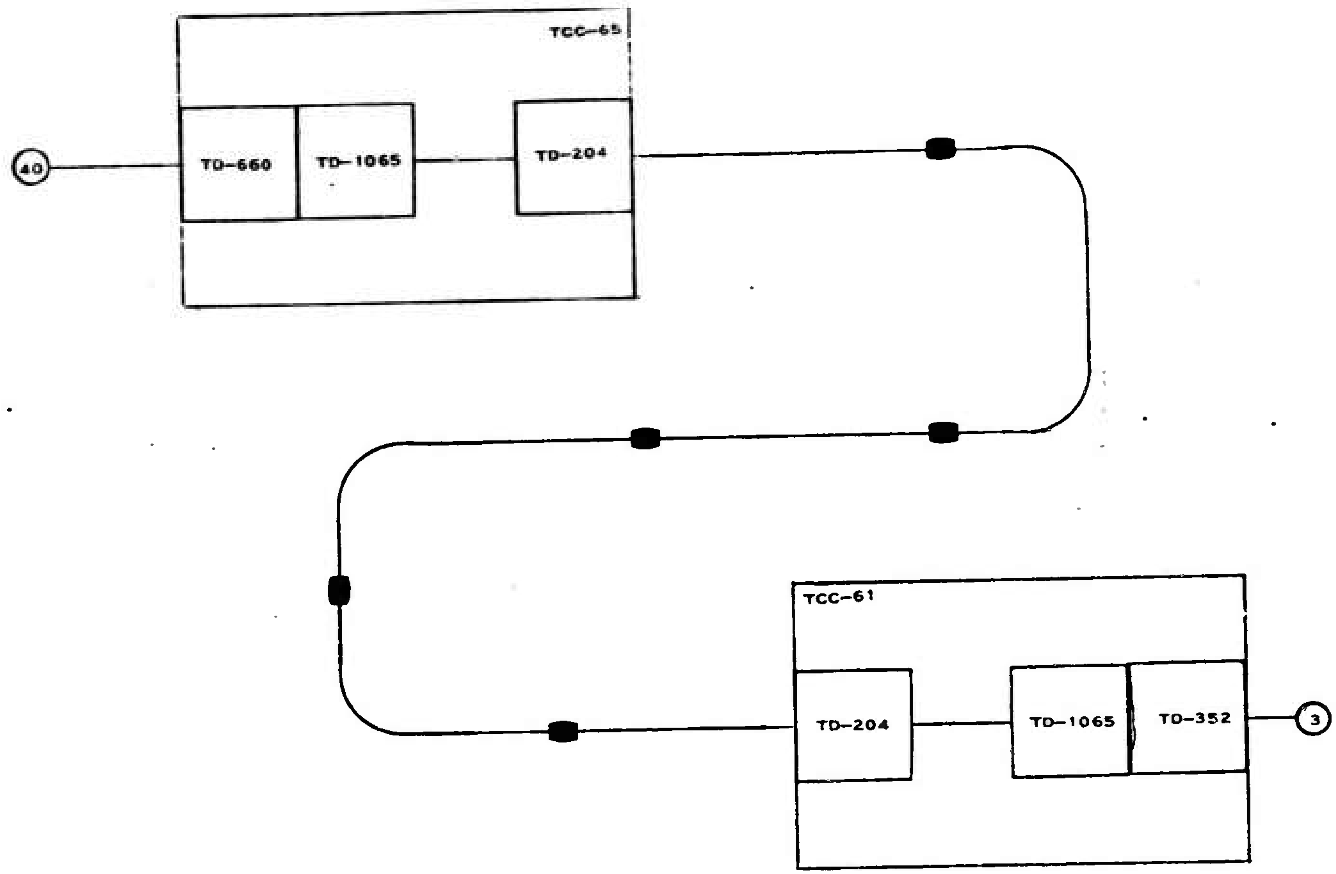

Figure 19. System test configuration (link D).

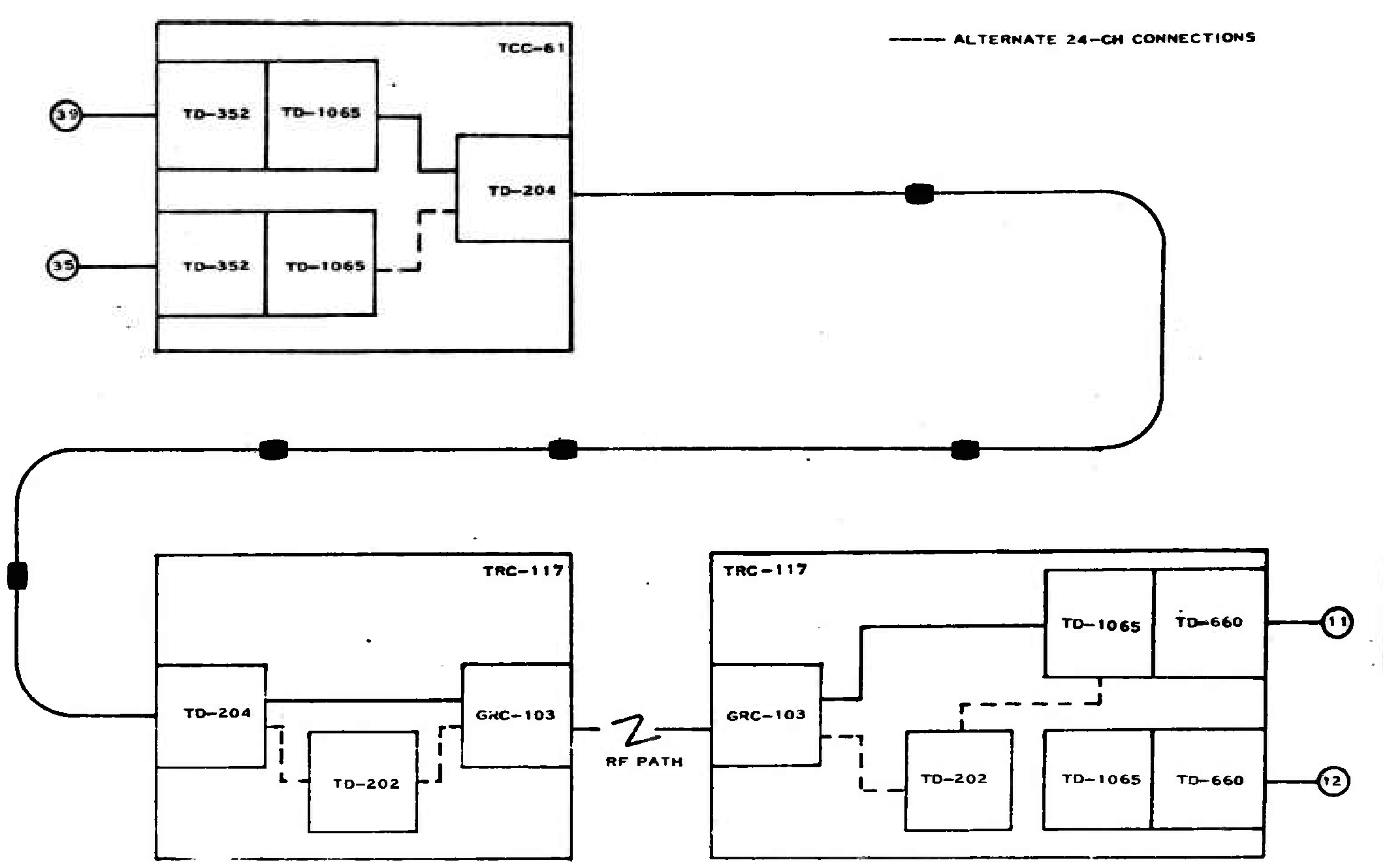

Figure 20. System test configuration (link E).

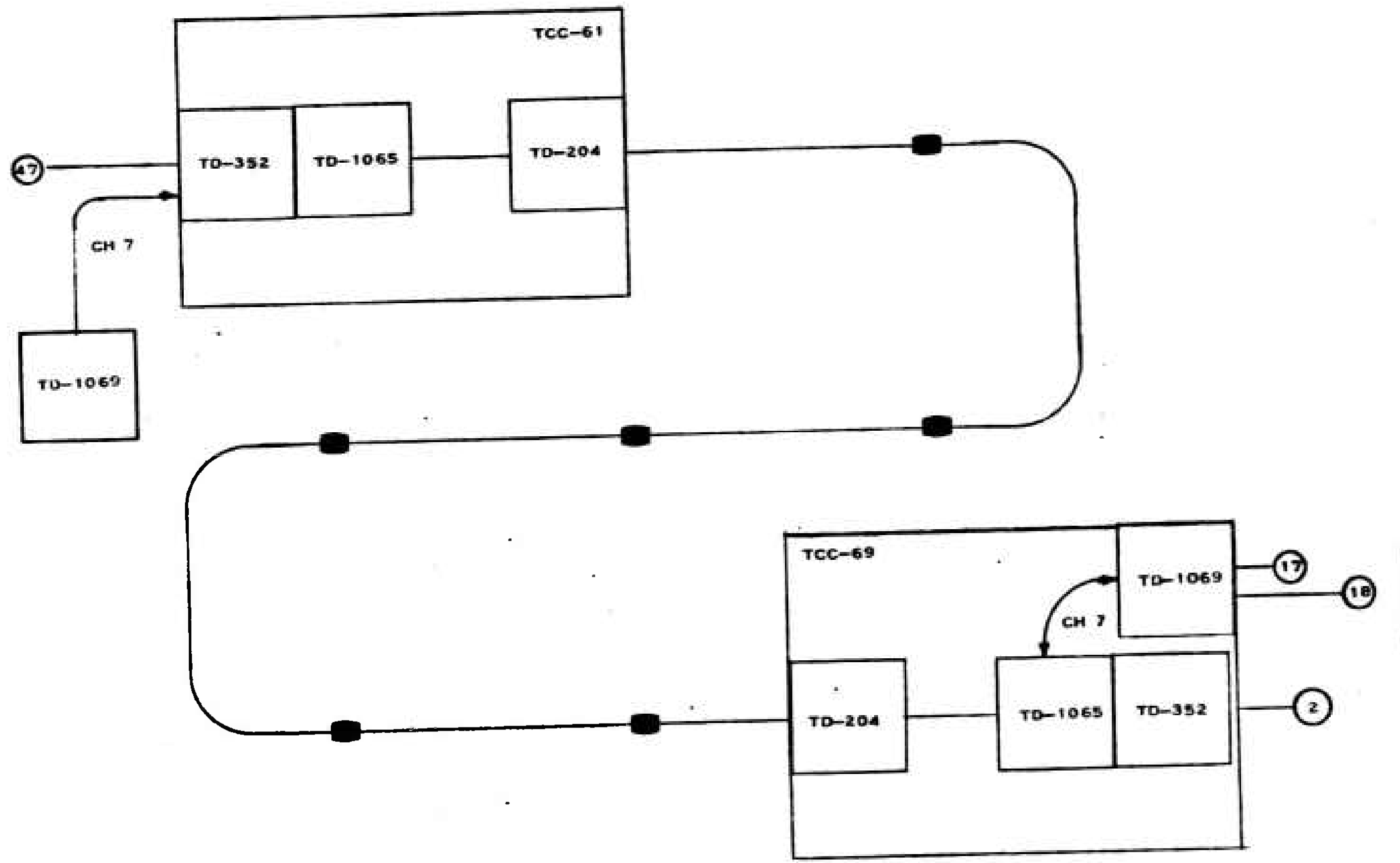

Figure 21. System test configuration (link F).

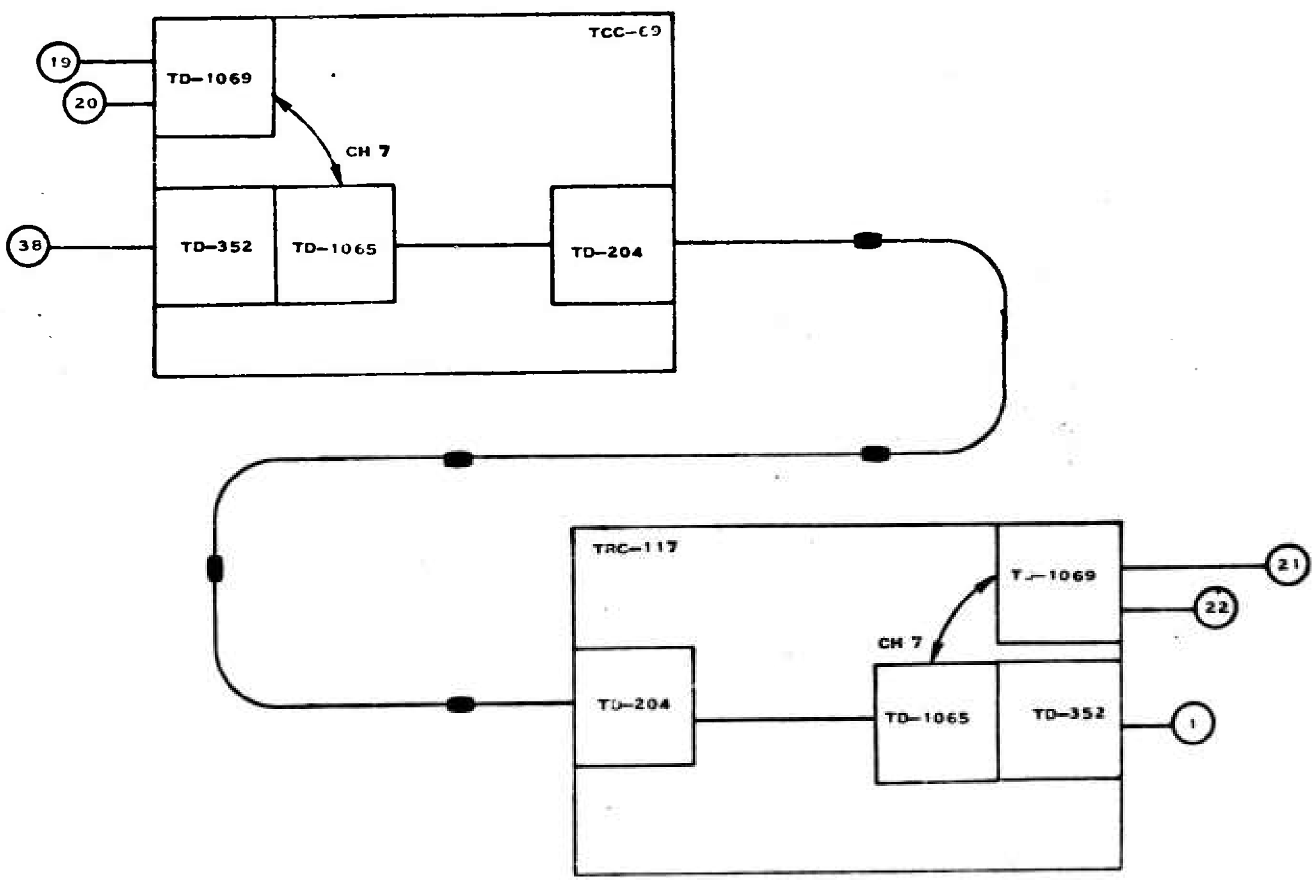

Figure 22. System test configuration (link G).

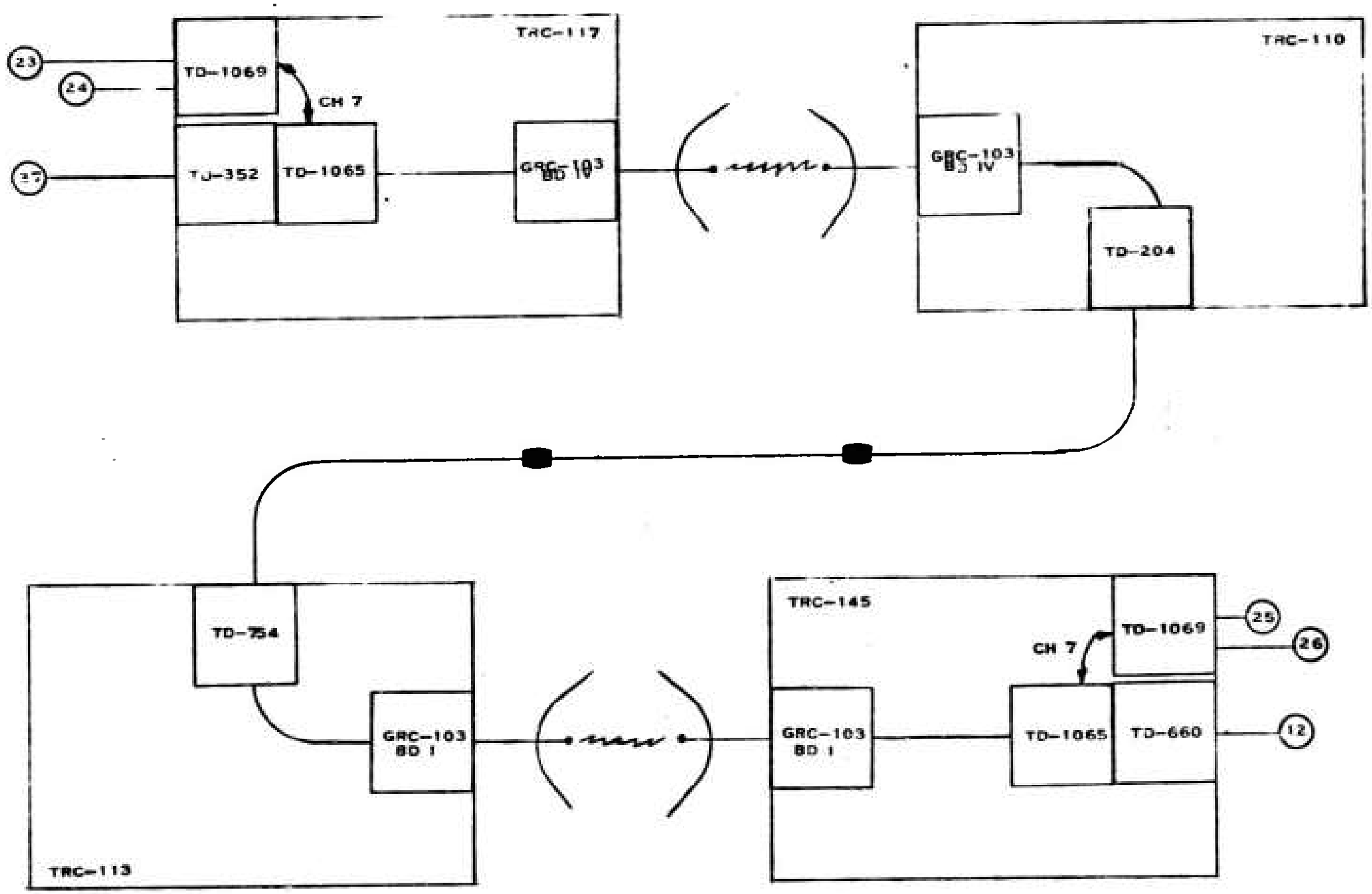

Figure 23. System test configuration (link H).

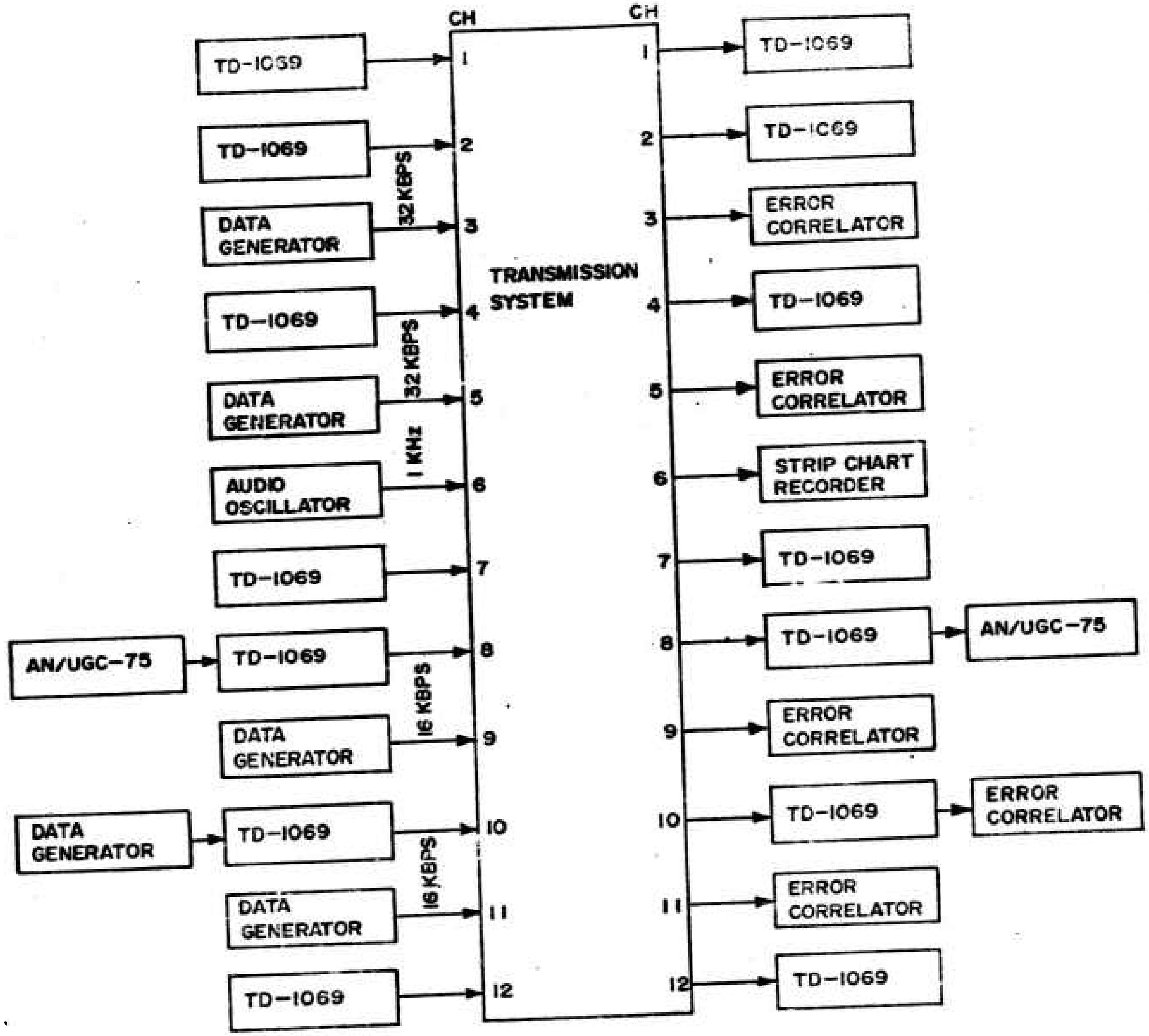

Figure 24. System test digital subscriber configuration.

2.21.4 Results

The test results are tabulated in table XVII.

TABLE XVII. SYSTEM CONFIGURATIONS TEST RESULTS

Test No.	Test Configuration	Power Source	Total Drop-outs*	Total Random Errors	Test Length (hrs)
(Phase I)					
1	Link A (40-mile cable system)	Gen	4	0	24
2	Link A (¼-mile between assemblages)	Comm	1	13	24
3	Link A (40-mile cable system)	Gen	1	2	17
4	Link B	Gen	4	3	24
5	Link C	Gen	0	3	24
6	Link D	Gen	4	0	24
7	Link E	Gen	5	7	24
8	Link F	Gen	2	0	24
9	Link G	Gen	7	0	24
10	Link H	Gen	25	31	24
11	Link H	Comm	14	39	24
12	Link H (TD-204 in TRC-110 replaced with TD-754)	Gen	12	0	24
13	Link H-A (loop-back to provide GRC-103 (band I) only)	Comm	10	85	16
14	Link H-B (loop-back to provide GRC-103 (band IV) only)	Comm	7	0	24
	Phase I Totals		96	183	321
(Phase II)					
1	Tandem Links (Link C, Link H, Link H, Link C)	Comm	1	14	39
2	Tandem Links (Link C, Link C)	Comm	0	4	39
3	Test No. 2 in 24-channel mode	Comm	0	78	28
4	Link H	Comm	1	33533	24
	Phase II Totals		2	33629	130

*A dropout is defined as a loss of system synchronization resulting in a loss of BCI.

2.21.5 Analysis

a. The TD-1069 provided access for 24 channels of digital data into the ATACS trunking system.

b. During Phase I testing, the systems did not provide a satisfactory digital transmission capability as exhibited by the excessive number of dropouts occurring during the testing. The cause of these dropouts could not be determined at that time. Later, during a joint ECOM/USAEPG investigation using link configuration H as a test bed, several sources of dropout and error bursts were identified and observed as follows:

(1) Error bursts occurred during lightning storms. Errors were observed to be occurring coincidently with lightning strikes in the vicinity of radio receivers. Also, rain storms between transceivers increased the ambient error rate.

(2) Switching generators, while transmitting data, sometimes produces dropout/error bursts. They are considered to be due to momentary loss of power or switching transients on the power line.

(3) An intermittently defective TD-754 was isolated at the radio relay site. This TD-754 was used during the Phase I testing.

(4) Ringing the radio order wire signaling circuit does, in some cases, produce errors.

The above are considered to be the primary causes of the dropouts observed during the Phase I tests.

c. Phase II testing was conducted after replacing the defective TD-754 and using commercial power only. The system performance during Phase II showed a significant improvement over Phase I. The BER exhibited during the testing is considered insignificant in view of the total number of data bits transmitted except for Test No. 4 where 33533 erros were accumulated. 19983 of the 33533 errors during Test No. 4 were accumulated over a 2-hour period during a rain storm including lightning at the receiver terminal. Only two dropouts occurred during Phase II; whereas, 96 occurred during Phase I testing. This is considered to be a satisfactory level of performance (see also para 2.16.5).

d. It is considered that the problems encountered in establishing a satisfactory digital circuit transmission quality during this test identify a need for system/technical control procedures and test equipment which are not currently included in the system configuration. The analog test equipment and procedures currently available to operator/technical controllers do not evaluate the digital transmission capabilities of the various systems; therefore, the digital circuit quality would be unknown throughout a mission.

2.22 POWER

2.22.1 Objective

The objective was to determine the operational characteristics of the test item when subjected to variations in prime power source voltage and frequency.

2.22.2 Criteria (EL-CP0138-0001A)

a. The power supply shall be an integral replaceable subassembly of the TD-1069, and shall provide all ac/dc voltage necessary for the operation of the internal circuitry. The input power requirement shall not exceed 125 watts. (Para 3.3.3)

b. The equipment shall be designed to operate from primary power having the following steady state voltage and frequency ranges: (Para 3.3.3.1)

(1) Voltage: 115 Vac ±10 percent.

(2) Frequency:

(a) 50 Hz ±5 percent.

(b) 60 Hz ±5 percent.

(c) 400 Hz ±5 percent.

2.22.3 Data Acquisition Procedure

a. The test was set up as shown in figure 2. The test item was connected to a variable power source. A voltmeter, ammeter, and wattmeter were connected between the power source and the test item.

b. The voltage and frequency to the test item were varied over the ranges shown in paragraph 2.22.4 below.

c. The test item was operated for at least 15 minutes at each data point. Digital test data was transmitted through three channels for 5 minutes each as follows: Channel 8 at 600 b/s, channel 16 at 4800 b/s, and channel 24 at 9600 b/s. The resultant bit errors, if any, at the receive side of the channel were noted.

d. This procedure was repeated on two test items (SN 10 and 20).

2.22.4 Results

The test items operated satisfactorily under each power variation condition. There were no bit errors detected for any power condition. The power consumption for test item condition was approximately 90 watts. The voltage, frequency, current, power, and bit error measurements for each test condition for test item SN 10 are shown in table XVIII. The results obtained on SN 20 were very similar, the only difference being slight variations in current readings.

TABLE XVIII. POWER VARIATIONS TEST RESULTS (SN 10)

Voltage (Vac)	Frequency (Hz)	Current (amperes)	Power (watts)	Bit Errors		
				600 b/s	4800 b/s	9600 b/s
103	47	1.2	90	0	0	0
127	47	1.05	90	0	0	0
103	50	1.2	90	0	0	0
127	50	1.1	90	0	0	0
103	53	1.1	90	0	0	0
127	53	1.2	90	0	0	0
103	57	1.2	90	0	0	0
127	57	1.1	90	0	0	0
103	60	1.2	90	0	0	0
127	60	1.05	90	0	0	0
103	63	1.2	90	0	0	0
127	63	1.1	90	0	0	0
103	380	1.15	90	0	0	0
127	380	1.0	90	0	0	0
103	400	1.1	90	0	0	0
127	400	1.0	90	0	0	0
103	420	1.15	90	0	0	0
127	420	1.0	90	0	0	0

2.22.5 Analysis

The test item is capable of operating from various 50, 60, and 400 Hz power sources without degradation of performance.

2.23 ALARMS

2.23.1 Objective

The objective was to determine the capabilities of the visual and audible alarms to alert the crew to system malfunctions.

2.23.2 Criteria (EL-CP0138-0001A)

a. Failure alarms for channel, common, power supply, and inter-unit signals shall be provided in the TD-1069. Provisions shall be made within the TD-1069 for remoting of an alarm condition. All alarm detection circuits shall be operational within 1 second after power application to the TD-1069. A time guard of 1 second delay shall prevent intermittent alarm indications. Alarm conditions shall be removed automatically when proper operation is restored. (Para 3.11)

b. A push button switch shall be provided on the front of the equipment so that the audible signal can be turned off for each occurrence. The operation of this signal shall be such that if the equipment were to recover from a failure after the audible alarm has been turned off, the audible signal will operate until the switch is returned to the normal position. Operation of the alarm ON-OFF switch shall turn off the audible signal without delay. (Para 3.11.1)

2.23.3 Data Acquisition Procedure

a. The test was set up as shown in figure 4.

b. The input signal connectors, MUX IN and CH IN, were disconnected, in turn, and the status of the alarms was noted.

c. Correct operation of the audible alarm switch was verified during step b above.

d. Correct operation of the remote alarm facility was verified by connecting a voltmeter across the pins of the remote alarm connector. The voltmeter was observed as the alarms were activated and the dc closure was verified.

2.23.4 Results

Operation of all alarms and controls was satisfactory.

2.23.5 Analysis

Performance of the failure alarms and controls was in accordance with the criteria.

2.24 BUILT-IN TEST FACILITY

2.24.1 Objective

The objective was to determine the operational characteristics of the built-in test and fault location equipment and the capabilities of the test item to be maintained while in operation.

2.24.2 Criteria (EL-CP0138-0001A)

a. The TD-1069 shall have an integral test facility for the measurement, testing, and monitoring of signals in and out of the TD-1069 and of the operation of the internal circuits. The test facility shall include test oscillators, a method to measure dc power supply voltages, and GO NO-GO fault location circuitry to isolate failure to a particular plug-in printed circuit card. (Para 3.7)

b. The internal test facility shall be designed such that it may be operated without interrupting traffic or interfering with normal system operation. Removal of the integral test facility plug-in subassembly shall not affect operation of the TD-1069. (Para 3.7)

c. The test facility shall permit the operator to locate defective panels without external test equipment. It shall be possible to replace channel panels in the TD-1069 without interrupting traffic on any other channels. (Para 3.7.1)

2.24.3 Data Acquisition Procedure

a. The integral (built-in) test facility of the TD-1069 was used throughout the test period to determine the operational status of the TD-1069's and to isolate faults.

b. A test was conducted to determine whether operation of or removing the built-in test facility plug-in module interfered with normal operation of the test item. The test was set up as shown in figure 4. A BER test was run prior to and after removal of the plug-in module. The error rate was also monitored during operation of the voltage monitoring facility and alarm reset/lamp test switch. TD-1069's (SN 22 and 24) were used in this evaluation.

c. A test was conducted to determine the capabilities of the built-in test facility to isolated defective modules. Known defective circuit boards (see table XIX) were inserted in the test item and the fault location procedures as detailed in the technical manuals were followed in an attempt to isolate the fault. The indications on the TD-1069 and results of the fault location procedures were noted. TD-1069's (SN 22 and 24) were used in this evaluation.

2.24.4 Results

a. It was noted during the test that not all defects could be isolated using the built-in test facility (see para c below). The facilities provided for monitoring internal dc voltage levels and operational status were found to be satisfactory.

b. It was found that the TD-1069's could be operated with the built-in test facility plug-in module removed without degrading performance. Also, operating the built-in test facility did not interfere with normal operation.

c. The results of the fault location procedures evaluation are shown in table XIX.

TABLE XIX. FAULT LOCATION TEST RESULTS

Module	Defect	Isolated
A7, Port Card	R56 shorted to ground (BITE B held high)	No
A2, Xmit Timing and Control Card	TP E6 shorted to ground (OVERHEAD held high)	Yes
A3, RCV Timing and Control Card	TP E2 shorted to ground (subframe counter H output held low)	Yes
A4, Auto Channel Assignment Card	TP E1 shorted to ground (accumulator Q outputs held low)	No
A17, Ref Frequency Generator Card	TP E3 shorted to ground (R32 kHz held low)	Yes
A18 Frame Sync Card	TP E5 shorted to ground (RST-PO held low)	No

2.24.5 Analysis

a. The built-in test facility was found to be adequate for measurement and monitoring of signals in and out of the TD-1069 and dc power supply voltages.

b. The built-in test facility plug-in module could be removed without interfering with normal operation. Operation of the facility did not interrupt traffic.

c. The built-in test facility was found to be inadequate for isolation of defective plug-in modules. Three of the 6 known defects could not be isolated using the built-in facility and the procedures detailed in the technical manual. (Shortcoming)

2.25 INTERCHANGEABILITY

2.25.1 Objective

The objective was to determine the mechanical and electrical interchangeability of like parts.

2.25.2 Criterion (EL-CP0138-0001A, para 3.21)

Interchangeability between like assemblies, subassemblies, and replaceable parts shall be in accordance with Requirement 7 of MIL-STD-454D.

2.25.3 Data Acquisition Procedure

All of the channel modules, the common modules, and the power supplies in two units (SN 10 and 16) were interchanged and operational checks (para 2.4.3) were conducted on each.

2.25.4 Results

The results of the operational checks were satisfactory. It was noted that some of the plug-in modules were difficult to seat. The power supply modules were found to be extremely difficult to seat in some cases.

2.25.5 Analysis

The test item parts and assemblies were found to be electrically interchangeability. The mechanical problem of seating the modules could impact mission performance since it does delay corrective maintenance actions. The problem with the power supply modules is significant enough to be classified a shortcoming.

2.26 HIGH TEMPERATURE

2.26.1 Objective

The objective was to determine the ability of the test item to withstand the effects of high temperature extremes.

2.26.2 Criteria (EL-CP0138-0001A, para 3.13b)

The equipment shall be operable without degradation in specified performance at ambient temperatures up to $+145^{\circ}F$. The equipment shall withstand exposure, non-operating, to ambient air temperatures as high as $160^{\circ}F$.

2.26.3 Data Acquisition Procedure

a. Two test items (SN 10 and 16) were subjected to the high temperature test as specified in Method 501, Procedure II of MIL-STD-810B. The temperature in step 4 was $160^{\circ}F$ and $145^{\circ}F$ in step 7..

b. Performance checks (para 2.4.3) were made before, during, and after testing.

2.26.4 Results

Both items performed satisfactorily before, during, and after the test. There was no evidence of physical deterioration.

2.26.5 Analysis

The test item is capable of withstanding the effects of high temperature extremes without degradation.

2.27 LOW TEMPERATURE

2.27.1 Objective

The objective was to determine the ability of the test item to withstand the effects of low temperature extremes.

2.27.2 Criteria (EL-CP0138-0001A, para 3.13c)

The test item shall be operable without degradation in specified performance at ambient temperatures down to $-25^{o}F$. The equipment shall withstand exposure, non-operating to ambient air temperatures as low as $-70^{o}F$.

2.27.3 Data Acquisition Procedure

a. Three test items (SN 10, 16, and 20) were subjected to the low temperature test as specified in Method 502, Procedure I of MIL-STD-810B. The low storage temperature was set at $-70^{o}F$ for a period of 2 hours after stabilization. The low operating temperature was $-25^{o}F$.

b. Performance checks (para 2.4.3) were made before, during, and after testing.

2.27.4 Results

a. An initial low temperature test was conducted on two items (SN 10 and 16). Both items failed to operate at the low temperature extreme. Heavy frost was noted on the items.

b. At the request of ECOM, a second test was conducted on SN 16. During this test, SN 16 operated properly at the low temperature extreme.

c. A third test was conducted on SN 10 and SN 20. These items performed satisfactorily before, during, and after this test.

d. There was no evidence of any physical deterioration to any of the items tested as a result of the tests.

2.27.5 Analysis

The cause of the failure of the two test items during the first low temperature test could not be determined. The only difference between the first test and the two following tests was the presence of heavy frost on the test items. It is considered that the test item met the criteria since all items tested passed the second and third tests and the failures during the first low temperature test were not repeated.

2.28 HUMIDITY

2.28.1 Objective

The objective was to determine the ability of the test item to withstand the effects of a highly humid environment.

2.28.2 Criteria (EL-CP0138-0001A, para 3.13d)

The test item shall be operable without degradation in specified performance, and sustain no physical damage, during and after prolonged exposure to extreme high humidities as encountered in tropical hot coastal desert or other high humidity areas.

2.28.3 Data Acquisition Procedure

a. Two test items (SN 21 and 22) were subjected to the humidity test as specified in Method 507, Procedure II of MIL-STD-810B.

b. Performance checks (para 2.4.3) were made before, during, and after testing.

2.28.4 Results

a. At the end of the first 48-hour humidity cycle, the two test items failed to power up. The two power supply modules A1 (SN 2 and 8) were replaced and normal operation was restored. At the end of the second 48-hour humidity cycle the test items again failed to operate. The problem was traced to the power supply modules (SN 12 and 25). The humidity test was then completed with the two test items in a non-operating mode.

b. At the completion of the humidity test, the items were visually examined. The following deterioration was noted:

(1) Rust on the front cover retaining screws.

(2) White colored substance on power and phone ON/OFF switches. There was rust colored substance under the phone switch on SN 21.

(3) Red colored substance on back of the switch gate assemblies at the solder junctions.

(4) There was evidence of conformal coating deterioration (bubbling and clouding) on all printed circuit boards. This was especially bad on the frequency generator card in SN 21 and the BITE card in SN 22. There was rust on the crystal housing on the frequency generator card in SN 21.

(5) Inside the top cover, there was minor rust and corrosion on various solder terminals and hardware.

(6) Inside the back cover, the back plane wire wrap pins showed white and reddish brown substances on and near the pins.

(7) Inside the power supply module, there was rust and corrosion on various components and terminals. The printed circuit board inside the power supply showed the same conditions as paragraph (4) above.

c. Except for the defective power supply modules, the test items operated satisfactorily at the conclusion of the humidity test.

2.28.5 Analysis

a. The failure of the power supply modules during the humidity test is considered a deficiency.

b. The physical deterioration as a result of the humid environment is considered a shortcoming.

2.29 ALTITUDE

2.29.1 Objective

The objective was to determine the ability of the test item to withstand the effects of high altitude storage and operation.

2.29.2 Criteria (EL-CP0138-0001A, para 3.13a)

The equipment shall be operable without degradation in specified performance at altitudes up to 10,000 feet above mean sea level and shall withstand air transportation up to 17,500 feet.

2.29.3 Data Acquisition Procedure

a. The test item (SN 16) was subjected to the altitude test as specified in Method 500, Procedure I of MIL-STD-810B with the exception that the altitude in step 2 was 17,500 feet.

b. Performance checks (para 2.4.3) were made before, during, and after testing.

2.29.4 Results

The test item performed satisfactorily before, during, and after the test. There was no evidence of physical deterioration.

2.29.5 Analysis

The test item is capable of withstanding the effects of high altitude storage and operation without degradation.

2.30 DUST

2.30.1 Objective

The objective was to determine the effects of blowing sand and dust around the exterior of a mobile assemblage on a test item mounted within the assemblage.

2.30.2 Criteria (EL-CP0138-0001A, para 3.13e)

The equipment, in both operating and non-operating condition, shall withstand exposure to sand and dust particles with wind speeds of 35 knots surrounding the mobile enclosure containing the equipment, and shall be resistant to dust that may accumulate within the enclosure as a result of operator activity.

2.30.3 Data Acquisition Procedure

a. The test item (SN 16) was subjected to the dust test as specified in Method 510, Procedure I of MIL-STD-810B with the exception that the air velocity in steps 1, 2, and 3 was 20 ±30 feet per minute (to simulate the effect of a 35-knot wind outside a mobile assemblage on equipment mounted within the enclosure).

b. Performance checks (para 2.4.3) were made before and after testing.

2.30.4 Results

The test item performed satisfactorily before and after testing. There was no evidence of deterioration as a result of dust penetration.

2.30.5 Analysis

The test item is capable of withstanding the effects of blowing sand and dust as part of a mobile assemblage without degradation.

2.31 SALT FOG

2.31.1 Objective

The objective was to determine the ability of the test item to withstand the effects of a marine atmosphere.

2.31.2 Criterion (EL-CP0138-0001A, para 3.13f)

The equipment in its operating configuration shall be resistant to the effects of a salt-sea atmosphere.

2.31.3 Data Acquisition Procedure

Two test items (SN 17 and 20) were subjected to the salt fog test as specified in Method 509, Procedure I of MIL-STD-810B. Performance checks were made before, during, and after testing.

2.31.4 Results

a. At the conclusion of the salt-fog test, the units were visually inspected. The following was noted:

Exterior

(1) Rust on front cover retainer screws.
(2) Power and phone ON/OFF switches had corrosion on switch housings.
(3) Slight corrosion on power and alarm lamp housings.
(4) Slight corrosion around test meter screws.
(5) All cable connectors on the back show slight corrosion.

Interior

(1) Rust on switch gate assembly solder junctions.
(2) Rust or corrosion on filter assembly (A4 and A5) solder terminals (SN 17 only)
(3) Salt bridges between pins in the back plane (SN 17 only)

b. The performance check at the conclusion of the salt-fog test revealed both test items were in multiple alarm condition. After cleaning and drying, another performance check was made. Test item SN 20 performed satisfactorily. Two defective modules were found in SN 17:

(1) Frame Synchronization Module (SN 22) had cracked integrated circuit module at location U-12.

(2) Port Module (SN 732) had broken lead at the light emitting diode (LED).

2.31.5 Analysis

a. The physical deterioration as a result of the salt-fog atmosphere is considered a shortcoming.

b. The performance defects in SN 17 that were found at the conclusion of the test could not be directly attributed to the salt-fog environment. It is difficult to determine when the integrated circuit was cracked or when the LED was damaged. These conditions probably existed when the test items were received and were aggravated to the point of failure by the salt-fog environment. Since one item (SN 20) performed satisfactorily after cleaning and drying and the failures of SN 17 are not attributed to the salt-fog environment, the test item is considered to have met the criterion from a performance standpoint.

2.32 FUNGUS

2.32.1 Objective

The objective was to determine the susceptibility of the test item to fungal growth.

2.32.2 Criteria (EL-CP0138-0001A, para 3.13g)

The test item shall provide no nutrients in materials, coating, or contaminant form or support fungal growth. Only inherently fungus resistant grades of materials, per Requirement 4 of MIL-STD-454D, shall be used.

2.32.3 Data Acquisition Procedure

a. The test item (SN 17) was placed in the fungus chamber and conditioned for 24 hours at a temperature of $84^{\circ} \pm 1.5^{\circ}F$ with a minimum relative humidity of 95 percent.

b. After conditioning, the test item was inoculated with a fungal spore suspension consisting of the following fungi:

(1) *Aspergillus flavus*

(2) *Aspergillus niger*

(3) *Aspergillus versicolor*

(4) *Penicillium funicolosum*

(5) *Chaetomium globosum*

c. The fungi were from 28-day-old cultures grown on potato dextrose agar, in screw-cap bottles. *Chaetomium globosum* was grown on sterile strips of filter paper on mineral salts. The spores were harvested in accordance with the procedures described in MIL-STD-810B, Method 508, and inoculated onto the test item which was then placed in the fungus chamber and incubated for 28 days. After the test period, a visual examination of external and internal parts surfaces was made for microbial growth and corrosion. Micro-organisms found growing on different substrates were aseptically removed for further study.

2.32.4 Results

a. The following areas of the test item (SN 17) supported fungal growth:

(1) Exterior surface. A uniform moderate growth of *Aspergillus flavus* and a negligible amount of *Aspergillus niger* were observed on the exterior surface of the test item.

(2) Top interior. The wire ties maintained a moderate amount of Aspergillus versicolor and spotted colonies of Penicillium funiculosum. The voltage select switch and the ON/OFF terminal switch (telephone) supported a moderate growth of predominantly Penicillium funiculosum and Aspergillus niger with sparse colonies of Aspergillus flavus. The EMI gaskets were highly infected with Penicillium funiculosum. Aspergillus flavus and Aspergillus niger grew moderately on the RFI filters which were heavily corroded near the terminal studs.

(3) Back interior. The gaskets and all the data connectors allowed moderate amounts of fungi to grow. Aspergillus flavus was the predominant species isolated. Aspergillus niger was also found growing in these areas to a lesser extent.

(4) Front panel (external). Growth on the alarm reset was heavy. Samples taken from this area were later identified as Aspergillus niger and traces of Penicillium funiculosum. Growth on the alarm functional and traffic lights was Aspergillus niger and Aspergillus versicolor. Aspergillus flavus in moderate amounts and Aspergillus niger in more concentrated amounts were isolated from the surfaces of the phone connectors, voltage indicators, and the meter selector. The tracks to the PCB cards supported a moderate uniform growth of primarily Aspergillus niger and Aspergillus flavus with only small traces of Penicillium funiculosum.

(5) Power supply. Aspergillus flavus and Penicillium funiculosum were found growing in moderate amounts on the diodes, capacitors, and transformer. A slight amount of corrosion was observed on the diodes and capacitors.

(6) Chaetomium globosum was not isolated from any of the surfaces tested but was present in the controls set out within the chamber.

b. There was no damage or discoloration to the surface of the test item.

2.32.5 Analysis

a. Electrical wire ties and rubber gaskets when attacked by fungi over an extended period may cause them to become weak, break off, or come loose. The gaskets and ties should not be made of materials subject to fungi attack.

b. The surfaces of the tracks of the PCB cards must be sprayed with a suitable fungicide whenever fungus resistant material cannot be substituted.

c. Although fungi were observed on the coating of the transformers, the growth was not extensive and should not affect the component for a considerable length of time. Similarly, other areas of growth noted were light and will not have any effect on the operation of the unit.

d. The physical deterioration of the test item caused by fungal growth is considered a shortcoming.

2.33 VIBRATION

2.33.1 Objective

The objective was to determine the ability of the test item to withstand the effects of vibration incurred during vehicular transport.

2.33.2 Criterion (EL-CP0138-0001A, para 3.13h)

The test item shall withstand vibration induced during vehicular transport as part of a mobile assemblage over all types of roads and cross-country terrain and vibration induced during common carrier transport.

2.33.3 Data Acquisition Procedure

a. The test item (SN 10) was subjected to sinusoidal vibration in each of its three mutually perpendicular axes in two parts:

(1) Part 1 consisted of logarithmic cycling from 5 to 200 to 5 Hz. The sweep rate was 5 to 200 to 5 Hz in 12 minutes. Vibratory inputs to the test item was 1 inch double amplitude constant displacement from 5 to 5.5 Hz, and 1.5 g's peak constant acceleration from 5.5 to 200 Hz. Total test time per axis was 5-1/2 hours.

(2) Part 2 consisted of logarithmic cycling from 200 to 500 to 200 Hz. The sweep rate was 5 to 200 to 5 Hz in 3 minutes. Vibratory inputs to the test item were 1.0 g peak constant acceleration. Total test time per axis was 30 minutes.

b. The test item was visually inspected for physical damage and checked for proper operation (para 2.4.3) after each axis of vibration was completed.

2.33.4 Results

The test item operated satisfactorily before, during, and after the test. There was no evidence of physical deterioration.

2.33.5 Analysis

The test item is capable of withstanding the effects of vibration incurred during vehicular transport as part of a mobile assemblage without degradation.

2.34 VEHICULAR TRANSPORT

2.34.1 Objective

The objective was to determine the ability of the test item to withstand the stresses induced during vehicular transport as part of a mobile assemblage.

2.34.2 Criterion (EL-CP0138-0001A, para 3.13h)

The test item shall withstand vibration and shock induced during vehicular transport as part of a mobile assemblage over all types of roads and cross-country terrain.

2.34.3 Data Acquisition Procedure

a. The test item was installed in the modified ATACS assemblages and subjected to the vehicular transportation tests at Sacramento and Tobyhanna Army Depot. The tests were conducted in accordance with the appropriate assemblage specification. The assemblage, number of test items installed, and test procedures are shown in table XX.

TABLE XX. VEHICULAR TRANSPORT

Assemblage	TD-1069's Installed	Test Procedure
AN/TCC-69	2	Para 4.7, MIL-S-55584(EL)
AN/TCC-72	2	Para 4.9, MIL-S-55606C(EL)
AN/TRC-117	2	Para 4.9, MIS-S-55557A(EL)
AN/TRC-145	2	Para 4.9, MIL-S-55590C(EL)

b. Abbreviated performance checks (para 2.4.3) and visual inspections were made before and after testing.

2.34.4 Results

There was no change in performance levels during testing and the test item showed no evidence of physical deterioration.

2.34.5 Analysis

The test item is capable of withstanding the vibration and shock induced during vehicular transport as part of a mobile assemblage without degradation of performance.

2.35 RAIL TRANSPORT

2.35.1 Objective

The objective was to determine the ability of the test item to withstand the stresses induced during rail transport as part of a mobile assemblage.

2.35.2 Criterion (EL-CP0138-0001A, para 3.13h)

The test item shall withstand vibration and shock induced during common carrier transport.

2.35.3 Data Acquisition Procedure

a. The test item was installed in the modified ATACS assemblages and subjected to the vehicular transportation tests at Sacramento and Tobyhanna Army Depot. The tests were conducted in accordance with the appropriate assemblage specification. The assemblages, number of test items installed, and test procedures are shown in table XXI.

TABLE XXI. RAIL TRANSPORT

Assemblage	TD-1069's Installed	Test Procedure
AN/TCC-69	2	Para 4.10, MIL-S-55584(EL)
AN/TCC-72	2	Para 4.10, MIL-S-55606C(EL)
AN/TRC-117	2	Para 4.10, MIL-S-55557A(EL)
AN/TRC-145	2	Para 4.10, MIL-S-55590C(EL)

2.35.4 Results

There was no change in performance levels during testing and the test item showed no evidence of physical deterioration.

2.35.5 Analysis

The test item is capable of withstanding the stresses induced during rail transport as part of a mobile assemblage without degradation of performance.

2.36 DROP

2.36.1 Objective

The objective was to determine the ability of the test item to withstand the shocks encountered during loading and unloading in the field as part of a mobile assemblage.

2.36.2 Criterion (EL-CP0138-0001A, para 3.13h)

The test item shall withstand the shock induced during loading and unloading as part of mobile assemblage.

2.36.3 Data Acquisition Procedure

a. The test item was installed in the modified ATACS assemblages and subjected to the flat and rotational drop tests at Sacramento and Tobyhanna Depot. The tests were conducted in accordance with the appropriate assemblage specification. The assemblage, number of test items installed, and test procedures are shown in table XXII.

TABLE XXII. DROP TEST

Assemblage	TD-1069's Installed	Test Procedure
AN/TCC-69	2	Para 4.9, MIL-S-55584(EL)
AN/TCC-72	2	Para 4.11, MIL-S-55606C(EL)
AN/TRC-117	2	Para 4.11, MIL-S-55557A(EL)
AN/TRC-145	2	Para 4.11, MIL-S-55590C(EL)

b. Abbreviated performance checks (2.4.3) and visual inspections were made before and after testing.

2.36.4 Results

There was no change in performance levels during testing and the test item showed no evidence of physical deterioration.

2.36.5 Analysis

The test item is capable of withstanding shocks induced during loading and unloading as part of a mobile assemblage without degradation of performance.

2.37 BENCH HANDLING

2.37.1 Objective

The objective was to determine the ability of the test item to withstand shocks normally encountered during servicing.

2.37.2 Criterion (EL-CP0138-0001A, para 3.13h)

The equipment shall withstand shocks encountered in servicing.

2.37.3 Data Acquisition Procedure

The test item (SN 10) was subjected to the bench handling test as specified in Method 516.1, Procedure of MIL-STD-810B. Performance checks (para 2.4.3) were made before and after testing. The power supply module was tested separately and then reinstalled in the unit for the TD-1069 test.

2.37.4 Results

The test item operated satisfactorily before and after testing. No physical damage was noted.

2.37.5 Analysis

The test item is capable of withstanding the shocks normally encountered during servicing without degradation.

2.38 ELECTROMAGNETIC INTERFERENCE

2.38.1 Objective

The objective was to determine if the test item meets electromagnetic interference requirements.

2.38.2 Criterion (EL-CP0131-0001A, para 3.12.3)

The test item shall comply with the following emission and susceptibility requirements of MIL-STD-461A, Notice 4: CE02, CE03, CE04, CE05, CS02, CS06, RE02, RE02.1, RS03, and RS03.1.

2.38.3 Data Acquisition Procedure

a. General. The test item was set up in a shielded room in shelter configuration (AN/TCC-72) as shown in figure 25. Data sources and monitor tion were located outside the shielded room; data signals were conducted to the test item by 26-pair cables. Susceptibility was monitored at the error correlator and distortion analyzer.

b. CE02, Conducted emission, AC power leads, 10 to 50 kHz. The test item was set up as shown in figure 26, with all equipment operating. Conducted emissions on each power lead were measured by the current probe method.

c. CE03, Conducted emission, Control and Signal leads, 30 Hz to kHz. The test item was set up as shown in figure 27, with all equipment operating. Emissions were measured on each 26-pair cable by the current probe method.

d. CE04, Conducted emission, power leads, 50 kHz to 50 MHz. The test item was set up as shown in figure 26, with all equipment operating. Emissions on each power lead were measured by the current probe method.

e. CE05, Conducted emission, Signal and Control leads, 50 kHz to 50 MHz. The test item was set up as shown in figure 27, with all equipment operating. Emissions were measured on each signal lead by the current probe method.

f. CS02, Conducted Susceptibility, power leads, 50 kHz to 50 MHz. The test item was set up as shown in figure 28, with all equipment operating. Continuous wave signals were applied to the power leads as specified; susceptibility was monitored throughout the test.

g. CS06, Conducted susceptibility, power leads, spike. The test item was set up as shown in figure 29, with all equipment operating. Spike voltages (100 volts peak) were applied to the power leads. Susceptibility was monitored throughout the test.

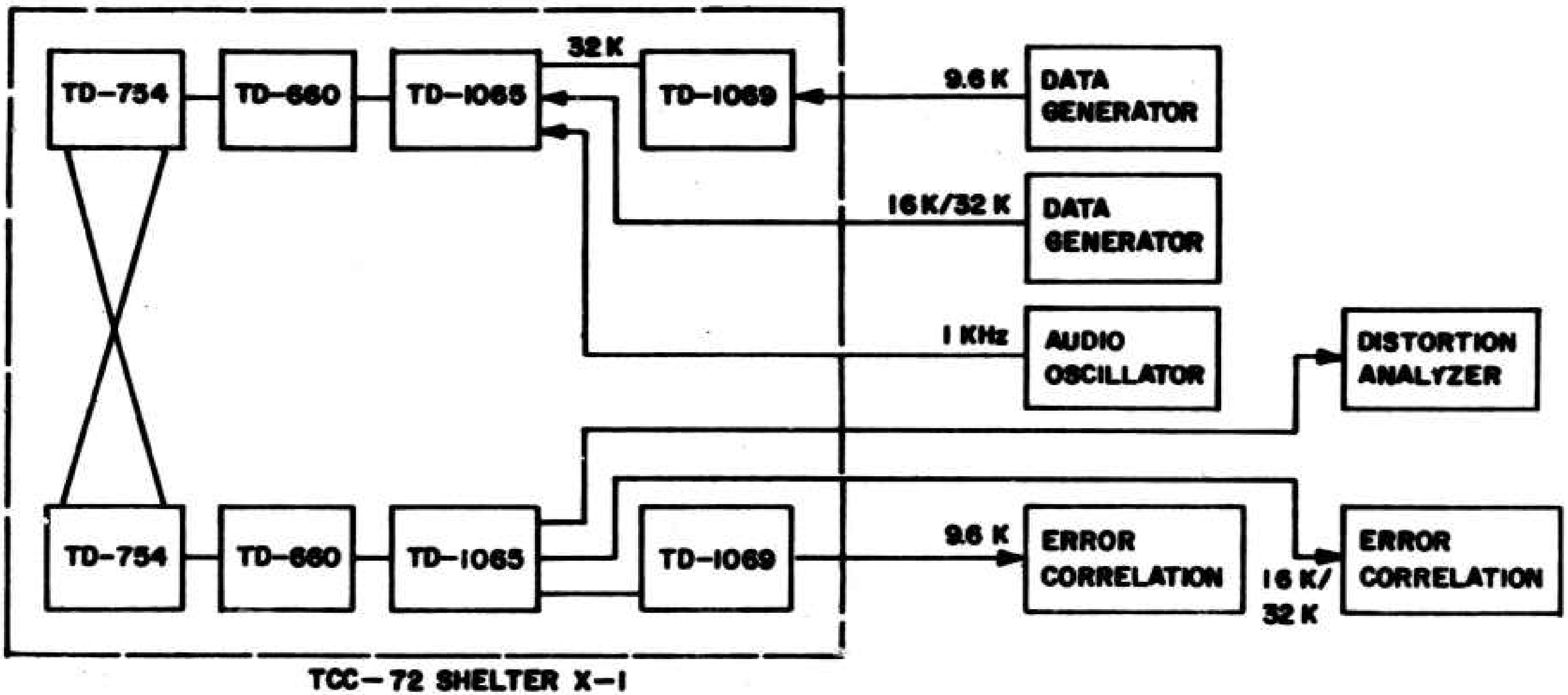

Figure 25. AN/TCC-72 interconnection EMI test.

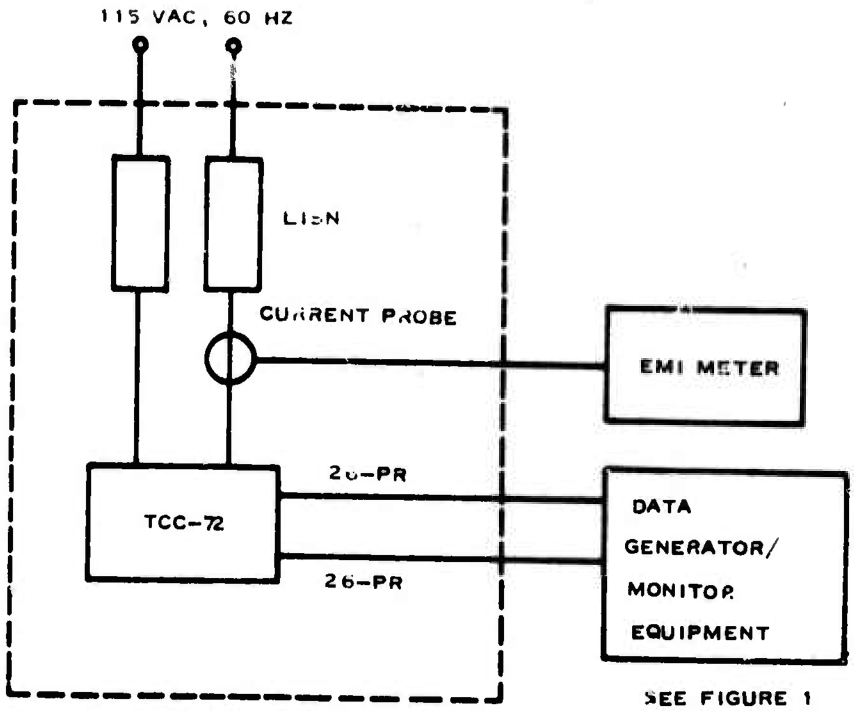

Figure 26. Test setup for CE02 and CE04.

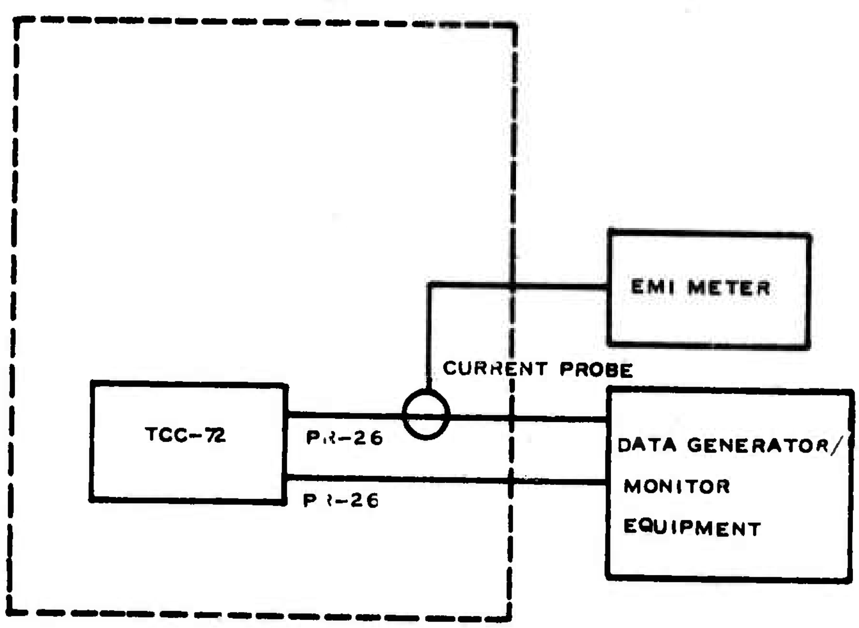

Figure 27. Test setup for CE03 and CE05.

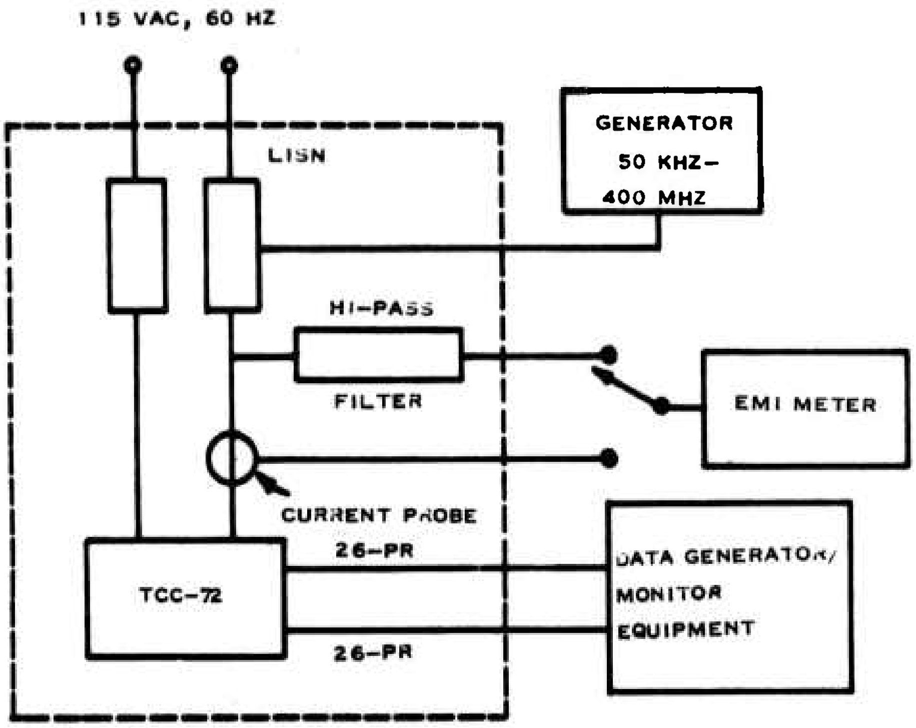

Figure 28. Test setup for CS02.

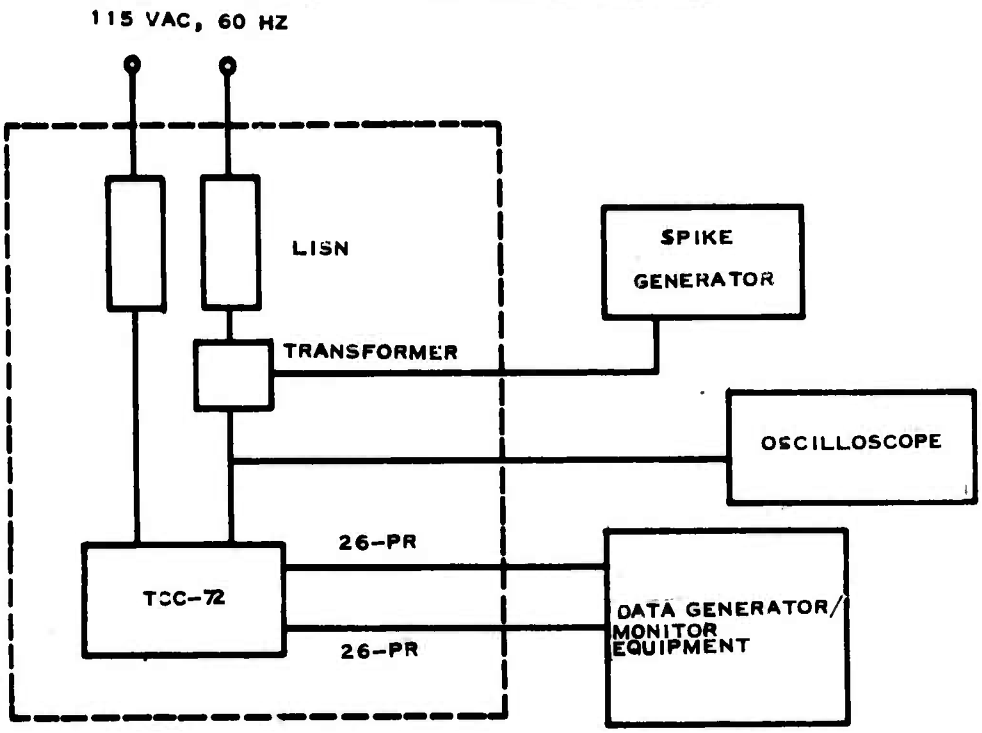

Figure 29. Teset setup for CS06.

h. RE02, Radiated emission, electric field broadband, 14 kHz to 1 GHz. Broadband emissions were measured on four sides of the test item as shown in figure 30. Test item data routing was changed as required to isolate emission sources; for example, TD-1065 was turned off, data path re-routed. A data link was also established entirely within the test item shelter; in this configuration, no data signals were conducted on the 26-pair cables.

i. RE02.1 Radiated Emission, (fig. 30) electric field narrowband, 14 kHz to 1 GHz. Broadband emission plots (from RE02) were analyzed to determine existence of narrowband emissions.

j. Radiated susceptibility, electric field, 14 kHz to 1 GHz (RS03) and RS03.1). The test item was subjected to electric field radiation at levels specified by the criteria. The four vertical sides of the test item were tested; doors and vents were closed unless required to be open for normal operation. Test setup is shown in figure 31. Required electric field levels were not achieved at 30 MHz to 1 GHz; actual applied levels averaged 20 volts per meter compared to the specified 50 volts per meter.

2.38.4 Results

a. CE02, Conducted emission, AC power leads, 10 kHz to 50 kHz. Emissions at the power leads were at least 8 dB below specified limits.

b. CE03. Emissions on the 26-pair cables were at least 15 dB below specified limits.

c. CE04. Emissions at the power leads were at least 15 dB below specified limits.

d. CE05. Emissions on the 26-pair cables were at least 15 dB below the limits.

e. CS02. No susceptibility conditions were noted during the test.

f. CS06. No susceptibility conditions were observed during the test.

g. RE02. Broadband emissions were above limits at frequencies 14 to 350 kHz as shown in figure 32. The worst condition was on the left side as the observer faces the door. Maximum emission was 18 dB above limits at 45 kHz. Operation with internal data loop (no data on the 26-pair cables) reduced emissions to 10 dB under the limits.

h. RE02.1. There were no narrowband emissions detected that were above broadband emission levels. When the unit was operated with internal data loop, narrowband emissions were at least 10 dB below the limits.

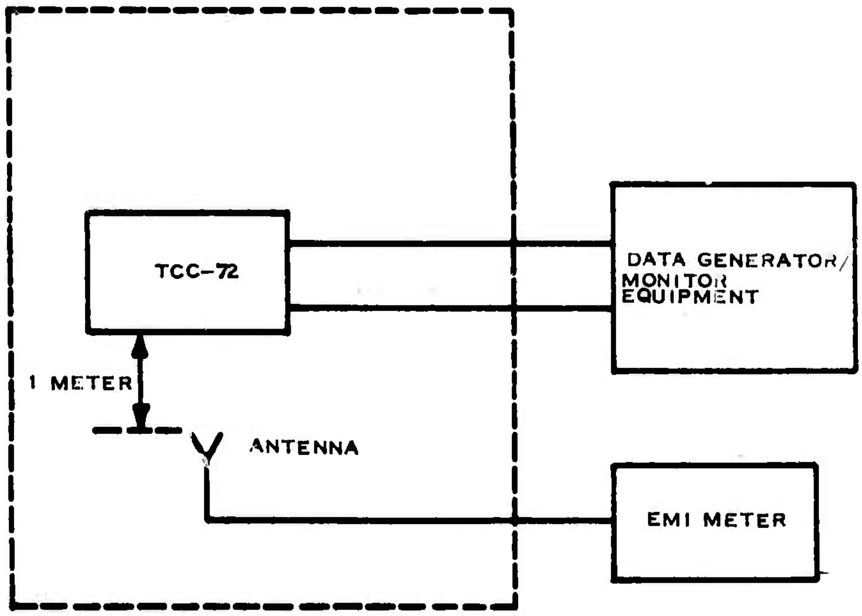

Figure 30. Test setup for RE02 and RE02.1.

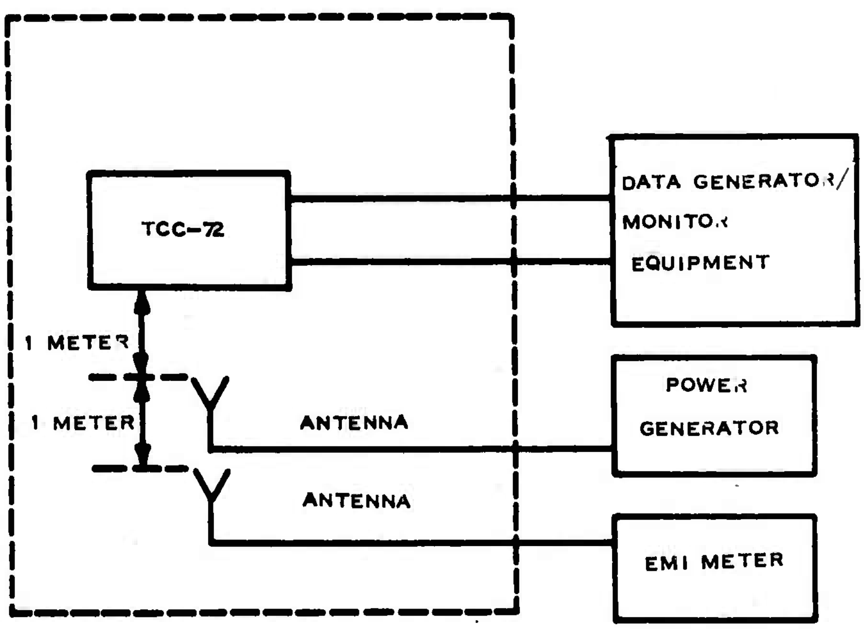

Figure 31. Test setup for RS03 and RS03.1.

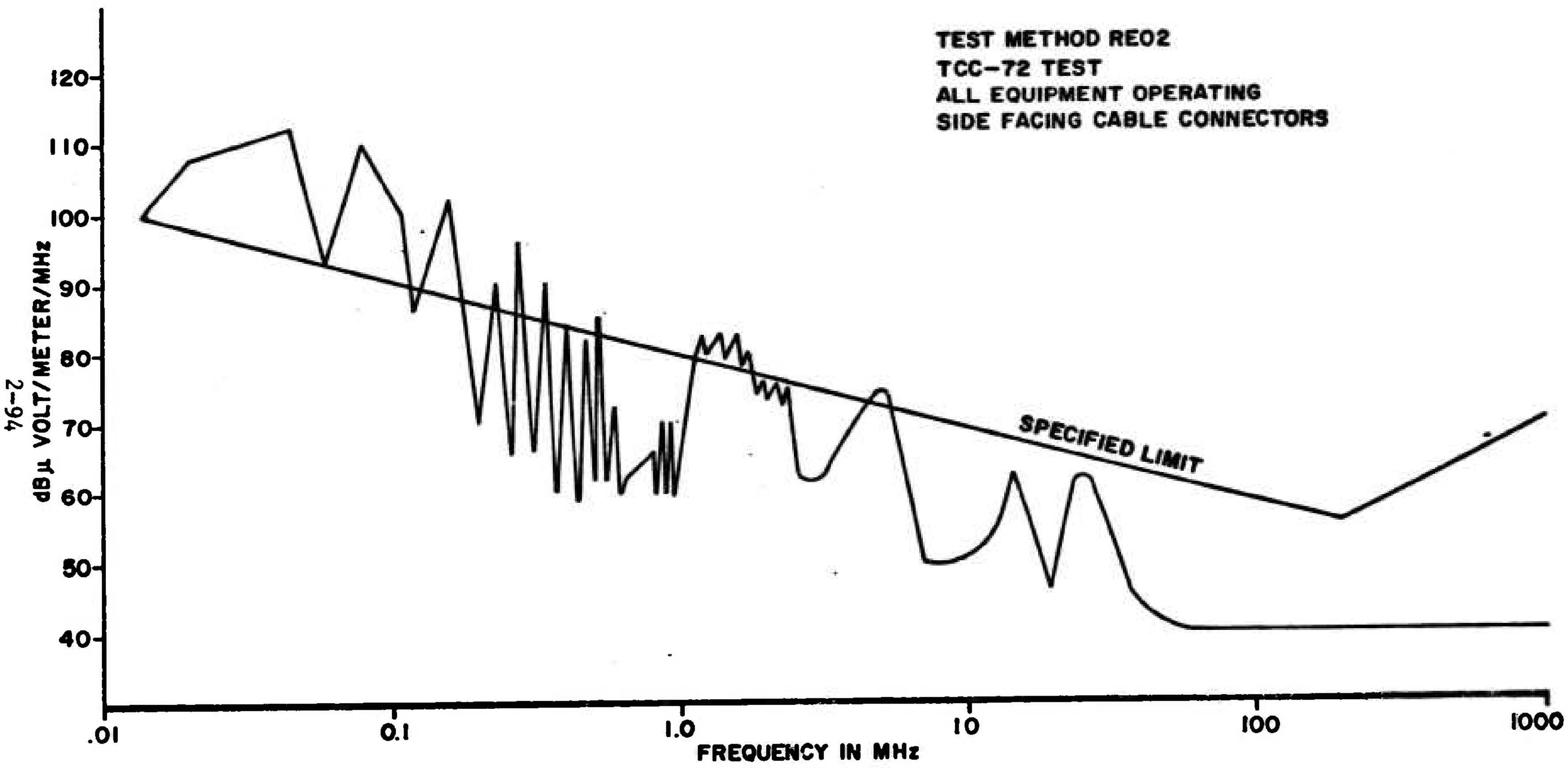

Figure 32. Test method RE02.

i. RS03 and RS03.1. No susceptibility conditions were observed during the test.

2.38.5 Analysis

a. The test item met requirements for CE02, CE03, CE04, CE05, CS02, CS06, RE02.1, and the limited tests of RS03 and RS03.1.

b. The test item did not completely meet the requirements for RE02. Broadband emissions up to 350 kHz are attributed to the 26-pair cables and their shelter connectors. Emissions at 350 kHz and below at the levels recorded are not considered to present a problem to communications-electronics equipment. Emissions occurring at 500 kHz and 1.3 MHz are over the limits but within the accuracy of measurement and may be discounted.

2.39 SIGINT AND VULNERABILITY TO JAMMING

2.39.1 Objective

The objective was to determine whether the addition of TD-1069 to an AN/GRC-103 radio link generates unique signal intelligence (SIGINT) characteristics or affects the vulnerability to jamming of the link.

2.39.2 Criteria (Approved Test Plan)

The addition of TD-1069 to the AN/GRC-103 radio link shall not --

a. Cause the generation of any unique SIGINT characteristics.

b. Degrade the electromagnetic vulnerability (EMV) characteristics to jamming of the radio link configuration without the test item.

2.39.3 Data Acquisition Procedure

2.39.3.1 SIGINT. Photographs were taken of the emission spectrum for 12-channel operation of the AN/GRC-103(V)IV with Multiplexer TD-660( )/G and the test item added for comparison with photographs taken previously during the SIGINT subtest of the Development Test (DT) II of the AN/GRC-103(V)IV.

2.39.3.2 Vulnerability

a. A closed-link (hard wired) configuration was used to make EMV performance characteristics measurements. The test was set up as shown in figure 33.

b. Measurements were made for the AN/GRC-103(V)IV with TD-660( )/G, TD-1065, and TD-1069 (12-channel operation) to determine the jamming-to-signal ratio (J/S) which would result in loss of synchronization. This measurement was made for desired signal (S) levels of -94, -75, and -56 dBm at a test link frequency of 1600 MHz for the three most effective jamming modulations as determined from the previous EMV subtest of the DT II of the AN/GRC-103(V)IV.

2.39.4 Results

Due to the classified nature of the test results, they will be provided under separate cover.

2.39.5 Analysis

An analysis will be provided under separate cover due to the classified nature of the subject matter.

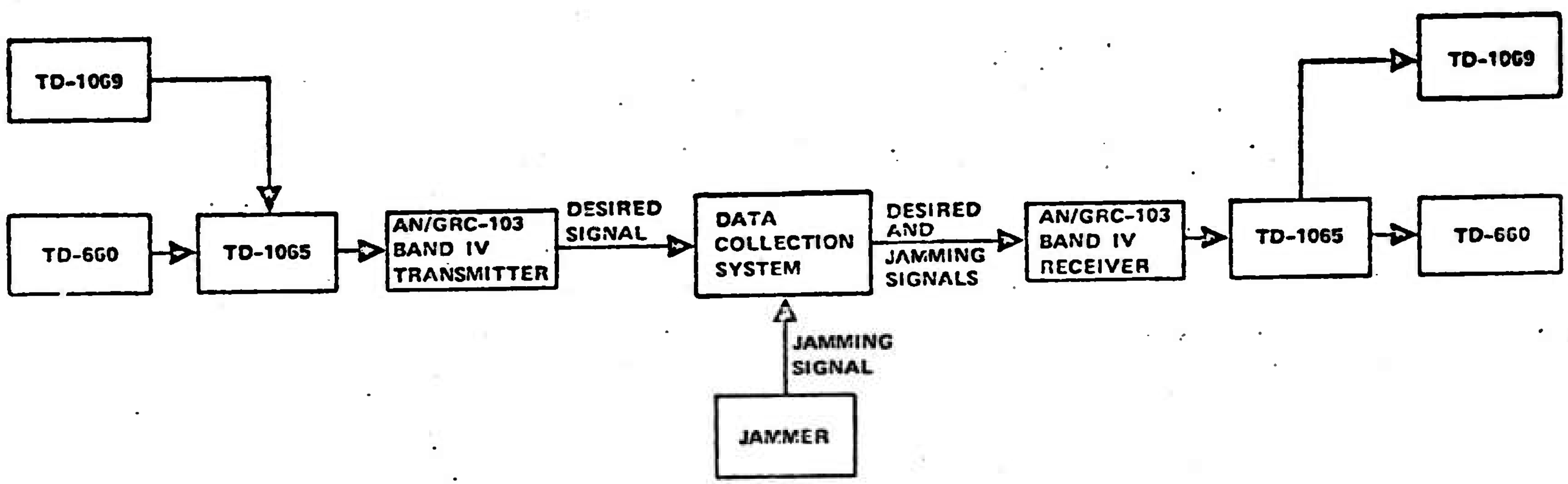

Figure 33. Vulnerability test link setup.

2.40 MAINTENANCE EVALUATION

2.40.1 MAINTAINABILITY INDICES

2.40.1.1 Objective. The objective was to acquire maintenance/maintainability data of the test item.

2.40.1.2 Criterion. The test item shall possess a mean corrective maintenance time no greater than 15 minutes, and a maximum corrective maintenance time no greater than 1 hour (95 percentile). (EL-CP0138-0001A, para 3.17)

2.40.1.3 Data Acquisition Procedure

a. Detailed maintenance logs were maintained throughout the test. Scheduled and unscheduled maintenance, equipment failures, and the methods used to repair the test item were recorded.

b. Military personnel of military occupational specialty (MOS) 35B and 31L were used to perform maintenance operations.

2.40.1.4 Results

a. All scheduled maintenance was performed/reviewed.

b. The following unscheduled maintenance data was accumulated:

	Organizational	Direct
Number of actions	13	3
Maintenance clock hours	4.8	4
Maintenance manhours	4.8	8

c. The organizational maintenance actions which were required as a direct result of environmental testing and the direct support actions to repair power supplies replaced at organizational level were included in mean time to repair (MTTR) and maximum corrective maintenance time ($M_{max\ ct}$) computations but were not included in maintenance ratio (MR) or achieved availability (A_a). These actions are labeled with an asterisk in the maintenance analysis chart (app C).

d. Simulated maintenance actions were performed on SN 13 after it had been removed from the reliability test. These actions are recorded separately in the maintenance analysis chart and are not included in computations. The faults listed in the remarks section for these actions are also simulated.

2.40.1.5 Analysis

a. Based on the accumulated data, the following computations were made in accordance with TECOM Supplement 1 to AR 750-1:

	Organizational	Direct	Overall
MTTR:	$\frac{4.8}{13} = 0.37$ hr (22 minutes)	$\frac{4}{3} = 1.33$ hrs	$\frac{8.8}{16} = 0.55$ hr
$M_{max\ ct}$ (95th percentile of log-normal distribution):	0.57 hr based on 13 actions	1.93 hrs based on 3 actions	1.2 hrs based on 16 actions

MR: $\frac{2.7}{10585} = 0.0003$

A_a: $\frac{10585}{10585+2.7} = 0.9997$

b. The test item easily met the $M_{max\ ct}$ at the organizational level. The demonstrated MTTR of 22 minutes at the organizational level exceeded the criterion of 15 minutes; however this is not considered excessive for this type of equipment.

2.40.2 TOOLS AND TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE)

2.40.2.1 Objective. The objective was to evaluate the suitability of the common and special tools and TMDE supplied with the test item.

2.40.2.2 Criterion. The special tools and test equipment outlined in the maintenance literature and/or contained in the maintenance test package shall be necessary and adequate for the performance of all required maintenance tasks at all field levels of maintenance when used in conjunction with the authorized common tools and test equipment contained in the applicable tool kits. Whenever possible, the design of a system should accommodate the use of common tools rather than special tools. Complicated test equipment requiring frequency calibration and restrictive environmental control conditions should be avoided. (AR 702-3, para 2-5)

2.40.2.3 Data Acquisition Procedure. Throughout the conduct of the test, operation and maintenance personnel utilized the tools and TMDE in the proper manner following the instructions contained in the manuals provided.

2.40.2.4 Results

a. Common tools and test equipment specified in the tools and test equipment requirement list of TM 11-5805-638-12 except the tool kit TK-105/G were used satisfactorily in support of the test.

b. Special test equipment received were a 9 and 15 pin connector which were used satisfactorily. Special test equipment available at the test site were used satisfactorily at their prescribed level of maintenance. The special test equipment listed in the tools and test equipment requirements list of TM 11-5805-638-12 are necessary to complete maintenance operations.

c. The tool kit TK-105/G does not provide a tool to remove the hex nuts from connectors J1, A4J1, J3, J4, A5J1, J6, J2, and J5 on the rear of the test item. (See fig. 34.)

d. A card extractor and card extender were provided with the test item. The card extractor was effectively utilized throughout the test. The card extender which is used to isolate faults on the printed circuit card assemblies had limited use by test personnel. The suitability of the card extender was not determined due to the fact that printed circuit card assemblies are repairable at depot maintenance.

e. A tool and TMDE chart was completed and included in appendix C.

2.40.2.5 Analysis

a. Common tools and TMDE except tool kit TK-105/G are suitable for their intended use.

b. Special test equipment listed in TM 11-5805-638-12 are necessary and adequate for their intended use.

c. The lack of an adequate tool in the tool kit TK-105/G to remove hex nuts from the connectors prevents the completion of authorized direct support maintenance operation. (Deficiency)

2.40.3 EQUIPMENT PUBLICATIONS

2.40.3.1 Objective. The objective was to determine if the equipment publications provided are suitable for their intended use.

2.40.3.2 Criterion. The equipment publications contained in the maintenance test package shall be complete, accurate, easy-to-read, consistent in nomenclature, simple to follow, and adequate to permit completion of both scheduled and unscheduled maintenance operations and parts acquisition at all field levels of maintenance. Draft Army equipment publications shall conform in content and format to that specified in AR 310-3, MIL-M-38784, and MIL-M-63000C (TM) series of military specifications as applicable. (AR 702-3, para 2-5)

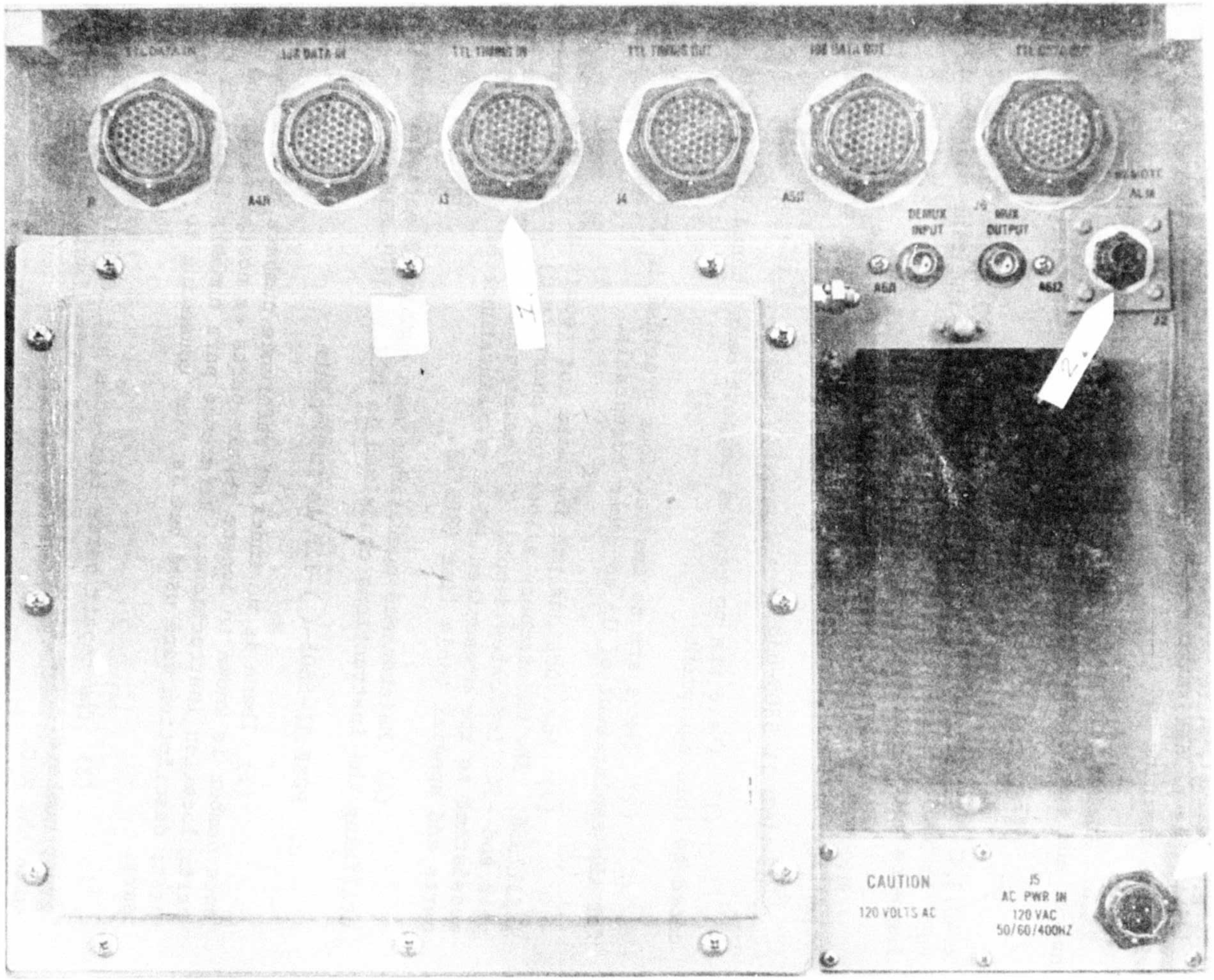

Figure 34. Hex nuts on connectors of test item.

2.40.3.3 Data Acquisition Procedure. Throughout the conduct of the test, the equipment publications were utilized and reviewed to permit:

a. Evaluation of operating manuals for simplicity, clarity, and completeness to determine whether operating instructions are commensurate with the training and skill of the operator.

b. Analysis of maintenance, troubleshooting, preventive maintenance, and safety instructions for simplicity, clarity, and completeness.

c. Detection of errors or omissions.

2.40.3.4 Results. Draft Technical Manuals (DTM) 11-5805-638-12, -34, PDEF 11-5805-( )-12P, -34P were used throughout the test and the following were noted:

a. DTM 11-5805-638-12 was used satisfactorily to perform operator/organizational maintenance operations. Minor changes are required.

b. DTM 11-5805-638-34.

(1) There are no general support maintenance operations allocated to this equipment.

(2) There are no instructions provided in DTM 11-5805-638-34 for the replacement of J5 ac power receptacle.

(3) Instructions are included for repair of power supply SME317356. The maintenance allocation chart (MAC) specified depot repair and -34P indicates depot. The maintenance instructions are not consistent to the prescribed level of maintenance of the MAC and repair parts and special tools list (RPSTL).

(4) Maintenance operations were completed satisfactorily by utilizing the instructions contained in DTM 11-5805-638-34.

c. PDEF 11-5805-( )-12P is incomplete.

(1) There is no index of reference numbers to use when a reference number is known to locate repair parts as contained in the repair parts location instructions. Reference part numbers listed in the repair parts description were used but is time consuming to identify replacement part.

(2) The repair parts list does not identify repair parts by group numbers. The grouping of repair parts listing is not consistent with the MAC.

d. PDEF 11-5805-( )-34P is confusing and incomplete.

(1) There are no callouts for identifying parts when a part number is unknown. Parts without part numbers labeled cannot be identified by soldiers in the field.

(2) The repair parts list is confusing and difficult to use. Repair parts are not listed by group numbers following the MAC group numbers.

e. A maintenance package literature chart was completed and included in appendix C.

2.40.3.5 Analysis

a. DTM 11-5805-638-12 with recommended changes is adequate for its intended use.

b. DTM 11-5805-638-34 with recommended changes is adequate for its intended use.

c. PDEF 11-5805-( )-12P due to the lack of an index of reference numbers, and inconsistent groupings of repair parts with the MAC extends time for completion of maintenance tasks. (Shortcoming)

d. PDEF 11-5805-( )-34P is inadequate due to the lack of callouts to identify repair parts without a part/reference number which prevents the identification/acquisition of repair parts by soldiers in the field. This may also cause delays in completion of maintenance operations. (Deficiency)

2.40.4 REPAIR PARTS

2.40.4.1 Objective. The objective was to determine the adequacy, compatibility, and requirement for the repair parts furnished.

2.40.4.2 Criterion. Repair parts shall be authorized in adequate quantities and diversity at the appropriate maintenance levels, consistent with the MAC, RPSTL, and skills required to install and align the parts. Repair parts which are used to maintain the system must be interchangeable with like parts being replaced. (AR 702-3, para 2-5)

2.40.4.3 Data Acquisition Procedure. Throughout the conduct of the test, repair parts furnished were compared with like parts being replaced for interchangeability and compatibility. Repair parts were examined with regard to their authorized maintenance level as indicated in the equipment manuals.

2.40.4.4 Results

a. Repair parts received with the test item were for replacement at the organizational maintenance level. Repair parts required to perform direct support level of maintenance were requested and received. Repair parts used during the test were necessary to complete maintenance tasks during the test.

b. Repair parts provided were evaluated as to their interchangeability and compatibility with like parts being replaced. No problems were encountered.

c. A review of repair parts was not accomplished due to inadequate direct support maintenance RPSTL.

d. A parts analysis chart was completed and included in appendix C.

2.40.4.5 Analysis

a. Repair parts used during the test were necessary and adequate for their intended use.

b. Repair parts used during the test are interchangeable and compatible with like items replaced.

c. Repair parts for direct support maintenance could not be examined to determine/compare the authorized/prescribed level of maintenance with the MAC due to inadequate RPSTL (for details see subtest 2.40.3).

d. Although the organizational and direct support maintenance repair parts received were adequate for their intended use, the evaluation of the repair parts for direct support maintenance is incomplete due to inadequate RPSTL.

2.40.5 DESIGN FOR MAINTAINABILITY

2.40.5.1 Objective. The objective was to determine the adequacy of the design for maintainability of the test item.

2.40.5.2 Criteria. Systems shall be designed to eliminate deficiencies prejudicial to the ease of maintenance. System design shall be directed toward minimizing maintenance by using the most reliable components, modular construction, built-in fault isolation test indicators, and other technological advances in components and methods to the maximum extent practicable. Means to achieve ease of maintenance include: (AR 702-3, para 2-5)

a. The location of high mortality parts to provide ready access when maintenance is required.

b. The use of readily accessible test points to reduce diagnostic time.

c. The reduction in the number of types and sizes of common fasteners (i.e., bolts, nuts, and screws) and the use of quick release fasteners, wing nuts, and other features which will minimize requirements for special or additional tools.

2.40.5.3 Data Acquisition Procedure

a. Authorized organizational maintenance operations listed in the MAC were performed as necessary to support and maintain the item during the test program. All preventive (scheduled) maintenance services prescribed by the manuals were performed and evaluated.

b. Direct and general support maintenance was performed as required. Each function on the MAC was performed or reviewed to the extent necessary to evaluated the maintainability of the test item.

c. The time required for individual maintenance operations was observed and recorded.

d. Maintenance operations were continuously monitored. Ease of access to components and test points; use of modular construction; and use of and adequacy of built-in GO NO-GO simple fault-isolation indicators were noted.

e. A review of the test item was made in regard to reliability of components, ability of protective devices to prevent damage during maintenance, and other factors which indicated that equipment design has been directed toward minimizing maintenance by using good maintainability design principles and characteristics of AMC Pamphlet 706-134.

f. Soldier-operator-maintainer tester comments were solicited.

2.40.5.4 Results

a. All preventive maintenance checks and services (PMCS) were performed and no difficulties were encountered. There is no general support maintenance prescribed for the test item. Direct support maintenance functions were performed as needed in support of the test. Simulated maintenance (teardown) operations contained in appendix _ were conducted to evaluate instructions contained in the equipment publications and evaluate the design for maintainability. The following were noted:

(1) Replacement of components mounted on the heat sink of power supply SME317356 is difficult, tedious, and very time consuming due to limited accessibility. (See fig. 35.)

(2) Replacement of modules 1A2 through 1A31 was difficult due to misalignment of printed circuit board (PCB) connector and bulkhead mating connectors in test items SN 9, 13, 17, 21, 22, and 24. Six out of ten test items had this problem.

(3) Throughout the test involving the test item, 6 of 22 power supplies failed. All power supply failures were a result of environmental (humidity and fungus) testing.

(4) The replacement of the power supply assembly SME317356 cannot be easily accomplished. The raised metal baseplate mount and the lack of sliding guides in the test item for the power supply assembly replacement causes difficulty in installing the power supply assembly.

(5) The screws on the bottom of the power supply assemblies extend their recess slots causing wear on the metal baseplate mount for the power supply in the test item. (See fig. 36.)

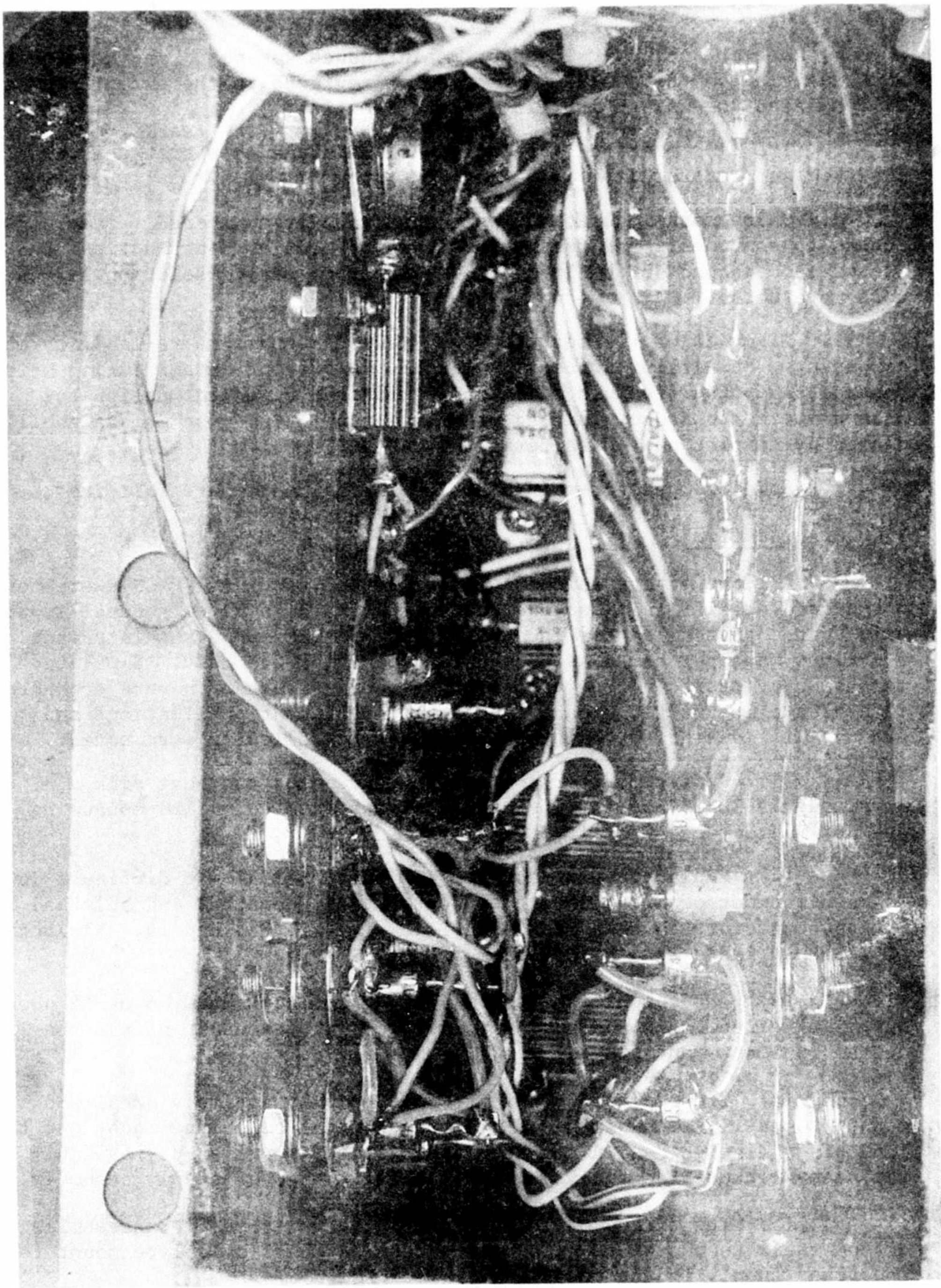

Figure 35. Congestion/limited accessibility of power supply components.

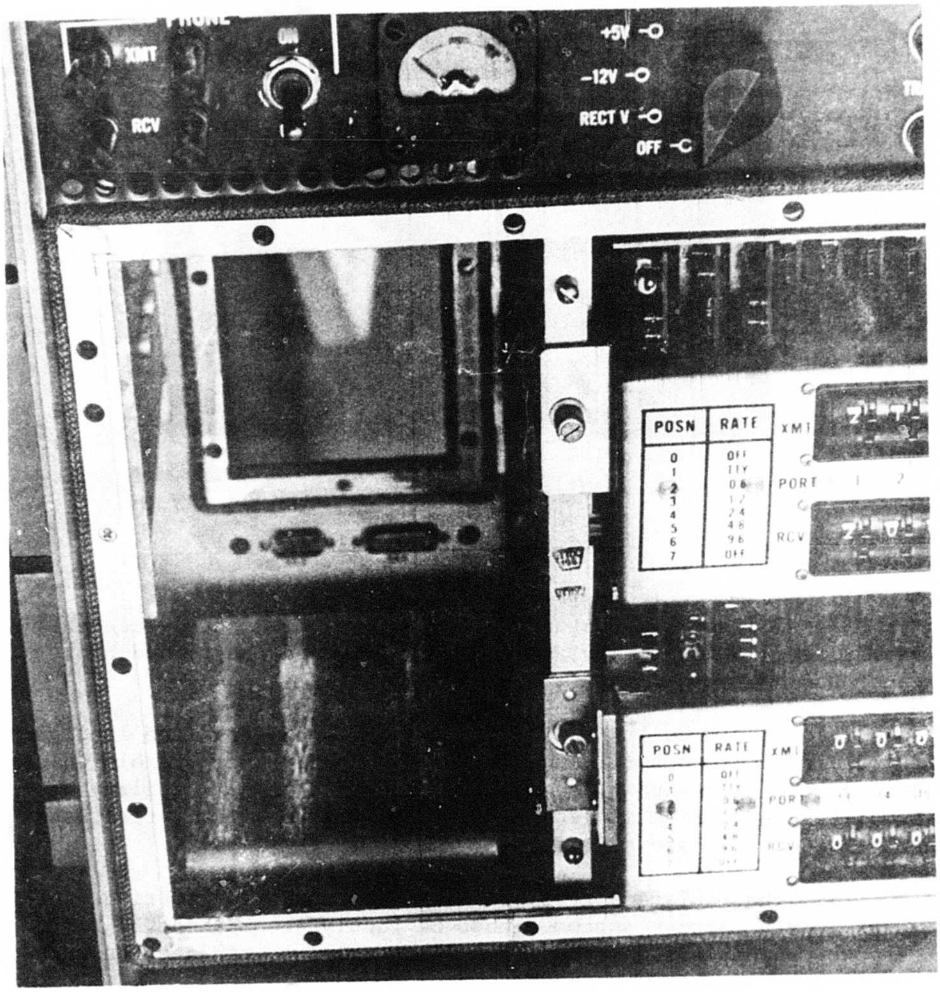

Figure 36. Wear of metal baseplate mount.

(6) The port modules A16 and A31 cannot be easily extracted due to limited accessibility. The locations of the port modules A16 and A31, and the hinged switch gate bracket's limited open position cause difficulty in extracting the port modules. (See fig. 37.)

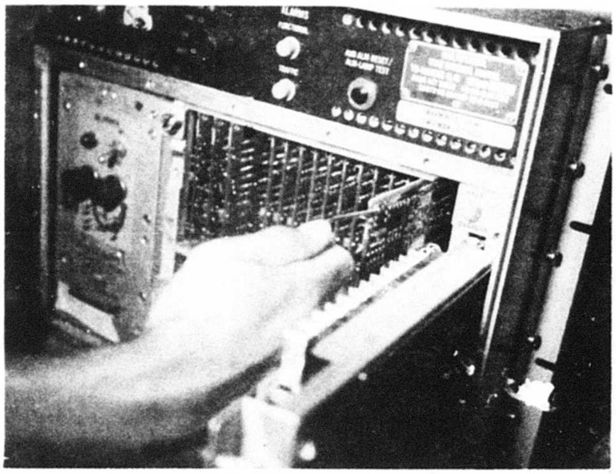

Figure 37. Extracting of port module (A16).

(7) The card extractor located on the power supply assembly is not easily removed due to limited accessibility and the curved hook design of the extractor.

(8) Simple built-in fault indicators and meters are incorporated but the fault indicators (light emitting diodes) are not visible unless the switch gate is opened. The built-in fault isolation facility was not completely effective in isolating all defective circuit card assemblies. (For details see para 2.24.)

(9) The replacement of the retaining (rubber "O") rings for the power supply captive screws cannot be easily accomplished. The case of the power supply assembly must be disassembled to replace the retaining "O" rings which hold the power supply screws captive.

(10) The guide pin receptacles on the face of the power supply can be easily confused in falsely representing a screw due to its slotted head design. The guide pin receptacles are bulky.

b. Soldier-operator-maintainer tester comments are included in appendix D, part B.

2.40.5.5 Analysis

a. The limited accessibility is prejudicial to the ease of maintenance because it extends maintenance time.

b. The misalignment of the connectors are prejudicial to the ease of maintenance because it extends maintenance time.

c. The failures of the power supplied involved in environmental testing demonstrate a component weakness which is not directed towards minimizing maintenance.

d. The difficulty in replacing the power supply assembly is prejudicial to the ease of maintenance.

e. The wearing of the baseplate mount demonstrates a weakness in design.

f. The difficulty to remove the card extractor from its mounted position is prejudicial to the ease of maintenance.

g. The incorporation of simple built-in fault indicators and meter is designed towards the ease of maintenance, however, because the visibility of the light emitting diodes is blocked by the switch gates, the identification of the defective PCB is delayed until the switch gate is opened. This is prejudicial to the ease of maintenance. Also, some defective circuit cards could not be isolated using the built-in test facility (see para 2.24).

h. The disassembly of the power supply assembly case to replace the retaining (rubber "O") ring is prejudicial to the ease of maintenance.

i. The slotted head on the guide pin receptacles demonstrates a weakness in design in that there are no screws to be threaded.

j. The findings in paragraphs 2.40.5.4a(1) through (10) constitute a shortcoming.

2.41 HUMAN ENGINEERING

2.41.1 Objective

The objective was to determine whether the item under test conforms to principles of human factors engineering (HFE).

2.41.2 Criteria (MIL-STD-1472B)

a. A display of the test item shall present needed information clearly and shall be visible from all reasonable viewing angles. (Para 5.5.1.1)

b. Components of the test item that must be located, identified, read, or manipulated shall be appropriately and clearly labeled to permit rapid and accurate human performance. Labels shall have high contrast and be mounted so as to minimize wear or obscurement by grease, grime or dirt. (Para 5.5)

c. The weight and special precautions in lifting shall be indicated on the components of the test item. (Para 4.1)

d. Cables shall be labeled to indicate the receptacles which they mate. The cable plugs shall be so designed that it will be impossible to insert a wrong plug into a receptacle whenever the possibility exists. Connectors shall be spaced far enough apart that they can be grasped firmly for connecting and disconnecting. (Paras 5.9.13 and 5.9.14)

e. The engineering traits of the test item shall be compatible with human limitations and capacities. (Para 4.1)

2.41.3 Data Acquisition Procedure

a. Data on display characteristics were obtained through examination, HFE checklist, and through interview of test participants.

b. Information concerning labeling was obtained through inspection.

c. Information on weight and special lift precautions was obtained through inspection.

d. Information on cable characteristics was obtained through inspection, HFE checklist, and interviewing test participants.

e. Soldier operator/maintainer personnel performed the tasks normally required in connecting the cables, setting-up, and operating the test item. During the performance an HFE specialist examined any difficulties encountered.

2.41.4 Results

a. Displays of the test item presented needed information clearly and the displayed information was visible from all reasonable viewing angles.

b. Components of the test item were appropriately labeled with suitable contrast between the symbols and adjacent background; however, the scheme used on the display panel was the reverse of the scheme used on other ATACS components (light lettering on dark background as opposed to dark lettering on light background) (e.g., TD-1065, TD-660, and TD-754).

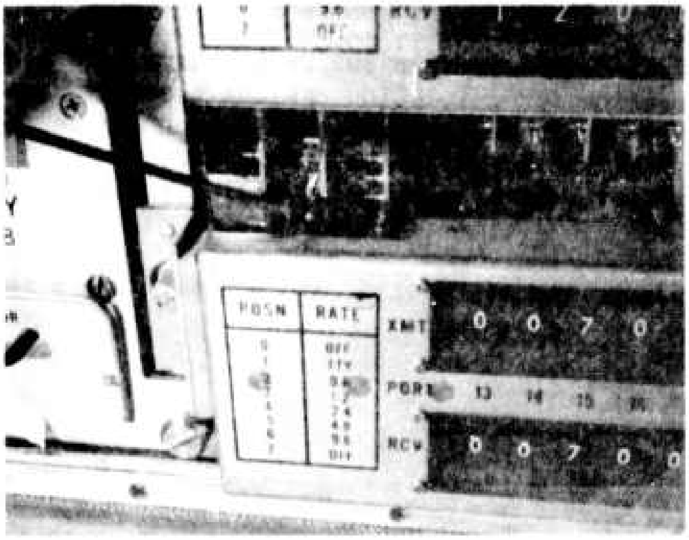

Figure 38. Location of channel assignment switch.

c. The weight and related instructions were posted on the test item.

d. Cables were labeled appropriately and indicated the corresponding receptacle. Cable connectors were difficult to grasp and remove/install due to the close spacing on the rear of the unit.

e. The engineering traits of the test item required operator functions which are compatible with human limitations and capabilities with exception of operating the channel assignment (manual reset) switch, which is difficult to reach with the finger tip to operate because of its location. (See fig. 38.)

2.41.5 Analysis

a. Displays of the test item are satisfactory.

b. Labeling is satisfactory except that color scheme (light lettering on dark background) on display panel is not consistent with the ATACS system.

c. Weight notations and related lift instructions are satisfactory.

d. The large size of the data/timing cable connectors and the close spacing at the rear of the test item made removal/installation difficult especially in shelter mounted configurations.

e. The channel assignment switch may have been placed in an inaccessible location for protection against breakage because it is a miniature switch which is fragile. The switch can be recessed to prevent breakage and still be easily accessible. Current arrangement requires excessive time for operation which is an inefficient man-machine relationship.

f. The items listed in b, d, and e constitute a shortcoming.

2.42 RELIABILITY

2.42.1 Objective

The objective was to determine the reliability characteristics of the test item.

2.42.2 Criterion (EL-CP0138-0001A, para 3.16.1)

The test item shall have a mean time between failure (MTBF) of 2,500 hours when used in the following manner:

Ambient Temperature - 45°C

Duty Cycle - Continuous Operation

Environment - Fixed Ground/Vehicle Mounted Ground

(NOTE: This is the criterion as it exists now and which is not in accordance with AR 702-3 minimum acceptable value (MAV) and specified value (SV)).

2.42.3 Data Acquisition Procedure

a. The operational configuration and performance measurements for this test were as described in paragraph 2.4.3. Four test items were operated continuously throughout the test with abbreviated operational checks performed twice daily and complete tests (para 2.4.3) conducted once every 168 hours. Operational checks were also made whenever alarms indicated a system failure.

b. The test conditions were as described in MIL-STD-781B for test level B. The duty cycle was 4 hours with 3½ hours ON time and ½ hour OFF time.

c. Additional operating hours were accumulated by using the test items in modified ATACS assemblages to determine compatibility during a system test.

d. Operating hours accumulated during electrical bench testing (excluding environmental testing) were reported separately.

2.42.4 Results

a. The test items were received with physical and operational defects. These incidents are reported in the visual and mechanical characteristics subtest, paragraph 2.3, and the operational characteristics subtest, paragraph 2.4.

b. The reliability test items accumulated the following number of operating hours and chargeable failures:

SN	Operating Hours	Chargeable Failures
9	1,521	0
12	1,521	0
13*	333	1
16	1,188	1
24	1,521	1
Total	6,084	3

*SN 13 was replaced with SN 16 after 333 hours (see para c(1) below.)

c. The chargeable failures during the reliability test are discussed below:

(1) SN 13 was replaced with SN 16 after 333 hours of operation. During the vibration portions of the test (10 minutes each hour), SN 13 would go into functional alarm. The alarm could not be reset without turning the power off and waiting several minutes. Troubleshooting could not find any defective components. To expedite the test, a chargeable failure was assigned to SN 13 and the test item was removed from test. ECOM personnel later found a broken wire in the switch gate assembly.

(2) After 178 hours of operation, SN 16 went into functional alarm. A defective port module was isolated on channel 3. Digital transmission was not degraded even though the alarm indication was given, however this incident is classified as chargeable since the operator would suspect that transmission was being affected and maintenance would be required.

(3) After 264 hours of operation, SN 24 experienced data bit errors on channel 11. Forty-five errors were detected in 5 minutes at 9600 b/s. Fourteen errors were detected in 5 minutes at 4800 b/s. Fault isolation led to a defective port module.

d. Seven test items (SN 9, 13, 16, 20, 21, 22 (replaced by 10 after 45 hours), and 24) accumulated 586 operating hours each (4,102 hours total) with no chargeable failures during the conduct of the modified ATACS assemblages system test.

e. Two malfunctions classified as non-chargeable occurred during the system test:

(1) SN 21's power supply (power supply SN 8) was replaced to remedy an intermittent shut-off which was occurring nearly every ½ hour after 24 hours into the system test. This power supply had previously failed during humidity.

(2) SN 22 went into functional alarm every 10-20 minutes after 45 hours into system test. This test item had previously undergone humidity and its power supply (SN 2) had failed during humidity.

f. The following operating hours were accumulated during electrical bench testing with no chargeable failures:

SN	Operating Hours
9	17
17	20
24	14
13	13
12	13
10	87
22	79
16	71
20	47
21	38
Total	399

2.42.5 Analysis

a. For purposes of computing MTBF, a failure was defined as the inability of the test item to perform its required functions within the limits as described in the development specification EL-CP0138-0001A. Failures were categorized as relevant (chargeable) or non-relevant failures.

b. A relevant failure was defined as one that can be attributed, after failure analysis, to any of the following causes:

(1) Design defects.

(2) Manufacturing errors.

(3) Workmanship defects.

(4) Physical deterioration (such as wearout or fatigue).

(5) Tolerance degradation beyond the limits defined on the test data sheets.

c. A non-relevant failure was defined as one that can be attributed to one of the following causes:

(1) Damage resulting from improper installation.

(2) Failure of test instrumentation or monitoring equipment which was external to the unit on test.

(3) Damage resulting from accident or mishandling.

(4) Failure due to technician or operator errors.

(5) Dependent failures as defined in MIL-STD-781B (multiple failures defined in para 5.5.1(2)).

d. A point estimate MTBF for the test level B reliability test was computed to be $\frac{6084}{3} = 2{,}028$ hours.

e. Assuming an underlying exponential distribution, it can be stated with 80 percent confidence that the true MTBF of the test item is bracketed by the interval (based on test level B reliability test):

$$910.6 \text{ hours} \leq \text{True MTBF} \leq 5{,}521 \text{ hours}$$

f. Point estimates for the system and bench testing cannot be computed based on zero failures.

g. When no failures occur, an upper confidence limit cannot be computed. The lower one-sided 90 percent confidence limits for true MTBF were computed:

(1) System test.

$$1{,}781 \text{ hours} \leq \text{True MTBF}$$

(2) Bench tests.

$$173.3 \text{ hours} \leq \text{True MTBF}$$

h. There was no statistically significant difference (at the 5 percent level) among the results of the three tests (test level B, system, and bench). If the hours are combined, the overall point estimate MTBF was $\frac{10585}{3} = 3{,}528$ hours. The overall 80 percent confidence interval for true MTBF was:

$$1{,}584 \text{ hours} \leq \text{True MTBF} \leq 9{,}605 \text{ hours}$$

i. The test item's reliability exceeded the criterion.

SECTION 3 APPENDICES

APPENDIX A. TEST CRITERIA

Item	Source	Criteria	Applicable Subtest	Remarks
1		The test item shall meet the pertinent safety requirements of MIL-STD-454D and EL-CP0138-0001A, paragraph 3.18.	2.1	Not met. See shortcoming 2.1, app B.
2	EL-CP0138-0001A, para 3.4	The width shall not exceed 17¼ inches (43.82 cm). The depth shall not exceed 12 inches (30.48 cm). The height shall not exceed 14 inches (35.56 cm).	2.2	Met.
3	EL-CP0138-0001A, para 3.5	The weight of the test item shall not exceed 60 pounds. (27.27 kg)	2.2	Met.
4	EL-CP0138-0001A, para 3.23	Workmanship of the equipment shall conform to Requirement 9 of MIL-STD-454D.	2.3	Met.
5	EL-CP0138-0001A, para 3.6	The test item shall have the chassis and case integrated as a combination case in accordance with RDD-STD-2. The case shall be equipped with two handles for carrying. The handles shall not interfere with the ability to rack mount the equipment in a standard electronic equipment rack having dimensions conforming to MIL-STD-189. Mounting shall be accomplished by means of mounting brackets.	2.3	Partially met. The TD-1069 did not conform to RDD-STD-2. However this requirement was waived by ECOM (Ref 29, app E).
6	EL-CP0138-0001A, para 3.2	Data inputs may be at rates of 600, 1200, 2400, 4800, or 9600 b/s.	2.4	Met.
7	EL-CP0138-0001A, para 3.2	The transmit and receive section of a data channel in the TD-1069 shall be completely independent with respect to bit rate processing capability.	2.4	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
8	EL-CP0138-0001A, para 3.2.6.1a	The TD-1069 shall be capable of interfacing balanced conditioned diphase modulated data streams at any of the data rates cited in Item 6 above. The data sources shall conform to MIL-STD-188C requirements for data transmission. The TD-1069 shall extract timing from these data streams.	2.4	Met.
9	EL-CP0138-0001A, para 3.2.6.1c	The TD-1069 shall be capable of interfacing balanced NRZ data streams each with associated timing streams at rates cited in Item 6 above. The sources of these data and timing signals will be TTL elements. At the source, voltage levels from 0.0 to +0.4 volt shall denote a logic "0"; voltage levels from +2.4 to +5.0 volts shall denote a logic "1".	2.4	Met.
10	EL-CP0138-0001A, para 3.2.1	Binding posts shall be provided on the front panel of each TD-1069 for the interconnection of four-wire telephone such as the TA-341 to be used as an analog orderwire when no data traffic is carried in either direction.	2.4	Met.
11	EL-CP0138-0001A, para 3.2.6.4a	The input resistance of a channel specified to receive signals from balanced MIL-STD-188C drivers shall not be less than 6000 ohms between terminals of a port.	2.5	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
12	EL-CP0138-0001A, para 3.2.6.7	The channel output impedance of the MIL-STD-188C drivers shall not exceed 100 ohms.	2.5	Met.
13	EL-CP0138-0001A, para 3.2.6.4b	The input resistance of a channel specified to receive signals from balanced TTL drivers shall be nominal 130 ohms between terminals of a port.	2.5	Not met. Input impedance of TTL ports was 100 ohms and output impedance was 80 ohms; however there was no evidence of any performance degradation.
14	EL-CP0138-0001A, para 3.2.6.3.1	The longitudinal balance of each pair configured for the reception and transmission of either conditioned diphase modulated data or teletypewriter traffic shall not be less than 40.0 dB.	2.6	Partially met. Two of the 25 output longitudinal balance measurements exceeded specified limits however, there was no evidence of any degradation.
15	EL-CP0138-0001A, para 3.2.6.5	The input channels of the TD-1069 shall be capable of detecting and processing balanced input signals at levels from 0.5 to 12 Vp-p.	2.7	Met.
16	EL-CP0138-0001A, para 3.2.3	The TD-1069 shall be capable of accepting data streams which have ±0.005 percent frequency tolerance.	2.7	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
17	EL-CP0138-0001A, para 3.2.6.8	The output signal waveshape, when operating in the MIL-STD-188C mode, shall conform to figure 2 of the Development Specification.	2.8	Met.
18	EL-CP0138-0001A, para 3.2.6.8	TTL signals shall be limited to rise and fall times at the interface of 1 μsec or greater.	2.8	Met.
19	EL-CP0138-0001A, para 3.2.6.2	The phase relationship between the TTL data and clock output signals shall be as indicated in figure 4 of the Development Specification.	2.8	Met.
20	EL-CP0138-0001A, para 3.2.6.6	The open circuit output voltage of a channel for balanced transmission shall be positive and negative 6 ±1 volts. Ripple shall be less than 0.5 percent under normal operating conditions. The balance between the positive and negative voltages shall be within 10 percent of each other.	2.8	Met.
21	EL-CP0138-0001A, para 3.2.6.6	For balance TTL transmission, a TD-1069 channel shall be capable of producing voltage levels from 0.0 to +0.4 volt for a logic "0" and from +2.4 to +5.0 volts for logic "1".	2.8	Partially met. The "1" level was found to be approximately +2.2 Vdc; however, there was no evidence of performance degradation.

Item	Source	Criteria	Applicable Subtest	Remarks
22	EL-CP0138-0001A, para 3.2.4	The TD-1069 shall provide for multiple channel access. The total input rate allocated (30 kb/s) shall be utilized to the fullest extent possible to provide a high degree of flexibility in the number of input channel configurations. The following channel configurations are required:	2.9	Met.
		a. Up to 24 channels of 600 b/s.		
		b. Up to 24 channels of 1200 b/s.		
22 (cont)		c. A 16-channel configuration of 9 channels at 2400 b/s and 7 channels at 1200 b/s.		
23	EL-CP0138-0001A	The input impedance of the TD-1069 demultiplexer section shall be 600 ohms (±10 percent).	2.12	Not met. Mean input impedance was found to be 545 ohms; however; there was no evidence of any performance degradation.
24	EL-CP0138-0001A	The output impedance of the TD-1069 multiplexer ports shall be 600 ohms (±10 percent).	2.12	Not met. Mean output impedance was found to be 520 ohms; however; there was no evidence of any performance degradation.

Item	Source	Criteria	Applicable Subtest	Remarks
25	EL-CP0138-0001A, para 3.2.8.3.1	The longitudinal balance of the MUX input pair shall not be less than 40 dB.	2.13	Met.
26	EL-CP0138-0001A, para 3.2.7.4.1	The longitudinal balance of the MUX output pair shall not be less than 40 dB.	2.13	Met.
27	EL-CP0138-0001A, para 3.2.8.3	The TD-1069 shall be capable of detecting and processing a multiplexer input signal whose level may range from 0.1 to 6.0 Vp-p.	2.14	Not met. The lower limit of the detection threshold was found to be 0.2 Vp-p; however there was no evidence of any performance degradation.
28	EL-CP0138-0001A, para 3.2.7.4	The TD-1069 shall provide a multiplexer output with transmission voltage levels of either 6 or 1 Vp-p ±10 percent when terminated in 600 ohms (±10 percent). The output levels shall be switch selectable.	2.14	Met.
29	EL-CP0138-0001A, para 3.2.7.1	The output data rate of the TD-1069 shall be 32.0 kb/s. The output shall have a frequency accuracy of ±0.001 percent at room ambient temperature.	2.15	Met.
30	EL-CP0138-0001A, para 3.2.7.2	The transmission format of the TD-1069 output bit stream shall be conditioned diphase. The output waveshape shall conform to figure 2 of the Development Specification.	2.15	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
31	EL-CP0138-0001A, Approved Waiver No. 6A	The TD-1069 shall acquire synchronization and BCI on a channel within 400 msec 80 percent of the time following application of a signal to the input of the receiver section.	2.17	Met.
32	EL-CP0138-0001A, para 3.3.1.1	The TD-1069 shall be capable of maintaining absolute BCI on a channel basis for a period of 24 hours in a random error environment of 1 error in 10^3 bits at a confidence level of 99 percent.	2.17	Not met. System drop-outs occurred during testing at a mean rate of one per 3.3 hours. See deficiency 1.1, app B.
33	EL-CP0138-0001A, para 3.2	The multiplexer section of the TD-1069 shall be capable of interfacing with a demultiplexer section via wire line transmission paths which may consist of up to 3 miles of WF-16 and up to 1000 feet of WM-130.	2.18	Met.
34	EL-CP0138-0001A, para 3.2.5	For TTY traffic, a 1200-b/s channel shall be enabled to accept and produce low level balanced TTY transmission at speeds as follows: a. ASCII 10.0 unit start-stop at 75.0 and 150.0 b/s. b. BAUDOT 7.0 unit start-stop at 45.50 ±0.09, 50.0, and 75.0 b/s. c. BAUDOT 8.0 unit start-stop at 45.50 ±0.09, 50.0, and 75.0 b/s.	2.19	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
35	EL-CP0138-0001A, para 3.2.5	TTY signal speeds shall be within ±5 percent of the rates specified in Item 34 above except as indicated and shall have less than 5 percent bias distortion.	2.19	Met.
36	EL-CP0138-0001A, para 3.2.5	The receive section of the TD-1069 shall demultiplex TTY signals with less than 20 percent mark to space, bias, or end distortion.	2.19	Met.
37	EL-CP0138-0001A, para 3.1	The TD-1069 shall provide a digital data transmission capability when used in conjunction with the TD-1065.	2.20	Met.
38	EL-CP0138-0001A, para 3.1	The TD-1069 shall provide a 24-channel digital data transmission capability when used in communication centers of the ATACS.	2.21	Met.
39	MN for TD-1069, para VIa(3)(h)	Installation of the TD-1069 into ATACS assemblages shall not degrade operation of the associated terminal equipment or the TD-1065.	2.21	Met.
40	EL-CP0138-0001A, para 3.3.3	The power supply shall be an integral replaceable subassembly of the TD-1069, and shall provide all ac/dc voltage necessary for the operation of the internal circuitry. The input power requirement shall not exceed 125 watts.	2.22	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
41	EL-CP0138-0001A, para 3.3.3.1	The equipment shall be designed to operate from primary power having the following steady state voltage and frequency ranges: a. Voltage: 115 Vac ±10 percent. b. Frequency: (1) 50 Hz ±5 percent. (2) 60 Hz ±5 percent. (3) 400 Hz ±5 percent.	2.22	Met.
42	EL-CP0138-0001A, para 3.11	Failure alarms for channel, common, power supply, and interunit signals shall be provided in the TD-1069. Provisions shall be made within the TD-1069 for remoting of an alarm condition. All alarm detection circuits shall be operational within 1 second after power application to the TD-1069. A time guard of 1 second delay shall prevent intermittent alarm indications. Alarm conditions shall be removed automatically when proper operation is restored.	2.23	Met.
43	EL-CP0138-0001A, para 3.11.1	A push button switch shall be provided on the front of the equipment so that the audible signal can be turned off for each occurrence. The operation of this signal shall be such that if the equipment were	2.23	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
43 (cont)		to recover from a failure after the audible alarm has been turned off, the audible signal will operate until the switch is returned to the normal position. Operation of the alarm ON-OFF switch shall turn off the audible signal without delay.		
44	EL-CP0138-0001A, para 3.7	The TD-1069 shall have an integral test facility for the measurement, testing, and monitoring of signals in and out of the TD-1069 and of the operation of the internal circuits. The test facility shall include test oscillators, a method to measure dc power supply voltages, and GO NO-GO fault location circuitry to isolate failure to a particular plug-in printed circuit card.	2.24	Met.
45	EL-CP0138-0001A, para 3.7	The internal test facility shall be designed such that it may be operated without interrupting traffic or interfering with normal system operation. Removal of the integral test facility plug-in subassembly shall not affect operation of the TD-1069.	2.24	Met.
46	EL-CP0138-0001A, para 3.7.1	The test facility shall permit the operator to locate defective panels without external test equipment. It shall be possible to replace channel panels in the TD-1069 without interrupting traffic on any other channels.	2.24	Not met. See shortcoming 2.2, app B.

Item	Source	Criteria	Applicable Subtest	Remarks
47	EL-CP0138-0001A, para 3.21	Interchangeability between like assemblies, subassemblies, and replaceable parts shall be in accordance with Requirement 7 of MIL-STD-454D.	2.25	Not met. See shortcoming 2.3, app B.
48	EL-CP0138-0001A, para 3.13b	The equipment shall be operable without degradation in specified performance at ambient temperatures up to +145°F. The equipment shall withstand exposure, non-operating, to ambient air temperatures as high as 160°F.	2.26	Met.
49	EL-CP0138-0001A, para 3.13c	The test item shall be operable without degradation in specified performance at ambient temperatures down to -25°F. The equipment shall withstand exposure, non-operating, to ambient air temperatures as low as -70°F.	2.27	Met.
50	EL-CP0138-0001A, para 3.13d	The test item shall be operable without degradation in specified performance, and sustain no physical damage, during and after prolonged exposure to extreme high humidities as encountered in tropical hot coastal desert or other high humidity areas.	2.28	Not met. See deficiency 1.1 and shortcoming 2.4, app B.
51	EL-CP0138-0001A, para 3.13a	The equipment shall be operable without degradation in specified performance at altitudes up to 10,000 feet above mean sea level and shall withstand air transportation up to 17,500 feet.	2.29	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
52	EL-CP0138-0001A, para 3.13e	The equipment, in both operating and non-operating condition, shall withstand exposure to sand and dust particles with wind speeds of 35 knots surrounding the mobile enclosure containing the equipment, and shall be resistant to dust that may accumulate within the enclosure as a result of operator activity.	2.30	Met.
53	EL-CP0138-0001A, para 3.13f	The equipment in its operating configuration shall be resistant to the effects of a salt-sea atmosphere.	2.31	Not met. See shortcoming 2.5, app B.
54	EL-CP0138-0001A, para 3.13g	The test item shall provide no nutrients in materials, coating, or contaminant form or support fungal growth. Only inherently fungus resistant grades of materials, per Requirement 4 of MIL-STD-454D, shall be used.	2.32	Not met. See shortcoming 2.6, app B.
55	EL-CP0138-0001A, para 3.13h	The test item shall withstand vibration induced during vehicular transport as part of a mobile assemblage over all types of roads and cross-country terrain and vibration induced during common carrier transport.	2.33	Met.
56	EL-CP0138-0001A, para 3.13h	The test item shall withstand vibration and shock induced during vehicular transport as part of a mobile assemblage over all types of roads and cross-country terrain.	2.34	Met.

Item	Source	Criteria	Applicable Subtest	Remarks
57	EL-CP0138-0001A, para 3.13h	The test item shall withstand vibration and shock induced during common carrier transport.	2.35	Met.
58	EL-CP0138-0001A, para 3.13h	The test item shall withstand the shock induced during loading and unloading as part of a mobile assemblage.	2.36	Met.
59	EL-CP0138-0001A, para 3.13h	The equipment shall withstand shocks encountered in servicing.	2.37	Met.
60	EL-CP0138-0001A, para 3.12.3	The TD-1069 shall comply with the following emission and susceptibility requirements of MIL-STD-461A, Notice 4: CE02 CS01 RE02* RS03* CE03 CS02 RE02.1* RS03.1* CE04 CS06 CE05 *Upper frequency limit = 1000 MHz.	2.38	Partillay met. The TD-1069 did not meet the requirements of RE02 at all frequencies; however, the emissions are not considered to present a problem to communications-electronic equipment.
61	Approved Test Plan	The addition of TD-1069 to the AN/GRC-103 radio link shall not -- a. Cause the generation of any unique SIGINT characteristics. b. Degrade the EMV characteristics to jamming of the radio link configuration without the test item.	2.39	See supplement No. 1.

Item	Source	Criteria	Applicable Subtest	Remarks
62	EL-CP0138-0001A, para 3.17	The test item shall possess a mean corrective maintenance time no greater than 15 minutes, and a maximum corrective maintenance time no greater than 1 hour (95 percentile).	2.40.1	Partially met. The demonstrated MTTR was 22 minutes, however, this is not considered excessive for this equipment.
63	AR 702-3, para 2-5	The special tools and test equipment outlined in the maintenance literature and/or contained in the maintenance test package shall be necessary and adequate for the performance of all required maintenance tasks at all field levels of maintenance when used in conjunction with the authorized common tools and test equipment contained in the applicable tool kits. Whenever possible, the design of a system should accommodate the use of common tools rather than special tools. Complicated test equipment requiring frequency calibration and restrictive environmental control conditions should be avoided.	2.40.2	Not met. See deficiency 1.2, app B.
64	AR 702-3, para 2-5	The equipment publications contained in the maintenance test package shall be complete, accurate, easy-to-read, consistent in nomenclature, simple to follow, and adequate to permit completion of both scheduled and unscheduled maintenance operations and parts acquisition at all field levels of maintenance. Draft Army equipment publications shall conform in content and format to that specified in	2.40.3	Not met. See deficiency 1.3, app B.

Item	Source	Criteria	Applicable Subtest	Remarks
64 (cont)		AR 310-3, MIL-M-38784, and MIL-M-63000C (TM) series of military specifications as applicable.		
65	AR 702-3, para 2-5	Repair parts shall be authorized in adequate quantities and diversity at the appropriate maintenance levels, consistent with the MAC, RPSTL, and skills required to install and align the parts. Repair parts which are used to maintain the system must be interchangeable with like parts being replaced.	2.40.4	Met.
66	AR 702-3, para 2-5	Systems shall be designed to eliminate deficiencies prejudicial to the ease of maintenance. System design shall be directed toward minimizing maintenance by using the most reliable components, modular construction, built-in fault isolation test indicators, and other technological advances in components and methods to the maximum extent practicable. Means to achieve ease of maintenance include: a. The location of high mortality parts to provide ready access when maintenance is required. b. The use of readily accessible test points to reduce diagnostic time.	2.40.5	Not met. See shortcoming 2.7, app B.

Item	Source	Criteria	Applicable Subtest	Remarks
66 (cont)		c. The reduction in the number of types and sizes of common fasteners (i.e., bolts, nuts, and screws) and the use of quick release fasteners, wing nuts, and other features which will minimize requirements for special or additional tools.		
67	MIL-STD-1472B, para 5.5.1.1	A display of the test item shall present needed information clearly and shall be visible from all reasonable viewing angles.	2.41	Met.
68	MIL-STD-1472B, para 5.5	Components of the test item that must be located, identified, read, or manipulated shall be appropriately and clearly labeled to permit rapid and accurate human performance. Labels shall have high contrast and be mounted so as to minimize wear or obscurement by grease, grime, or dirt.	2.41	Not met. See shortcoming 2.8, app B.
69	MIL-STD-1472B, para 4.1	The weight and special precautions in lifting shall be indicated on the components of the test item.	2.41	Met.
70	MIL-STD-1472B, paras 5.9.13 and 5.9.14	Cables shall be labeled to indicate the receptacles which they mate. The cable plugs shall be so designed that it will be impossible to insert a wrong plug into a receptacle whenever the possibility exists. Connectors shall be spaced far enough apart that they can be grasped firmly for connecting and disconnecting.	2.41	Not met. See shortcoming 2.8, app B.

Item	Source	Criteria	Applicable Subtest	Remarks
71	MIL-STD-1472B, para 4.1	The engineering traits of the test item shall be compatible with human limitations and capacities.	2.41	Not met. See shortcoming 2.8, app B.
72	EL-CP0138-0001A, para 3.16.1	The test item shall have an MTBF of 2,500 hours when used in the following manner: Ambient Temperature - 45°C Duty Cycle - Continuous Operation Environment - Fixed Ground/Vehicle Mounted Ground (NOTE: This is the criterion as it exists now and which is not in accordance with AR 702-3 MAV and SV.)	2.42	Met.

APPENDIX B. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
1.1 The test item failed to power up at the end of the 48-hour humidity cycle (para 2.28).	Replace defective power supply modules with ones having corrosive resistant cases.	Four power supply failures occurred during the test.
1.2 The tool kit TK-105/G does not provide a tool to remove the hex nuts from the connectors (para 2.40.2).	Proper tools should be supplied in TK-105/G tool kit.	The lack of an adequate tool in tool kit TK-105/G to remove hex nuts from the connectors prevents the completion of authorized direct support maintenance operation.
1.3 The repair parts list is confusing and difficult to use. Repair parts are not listed by group numbers following the MAC group numbers (para 2.40.3).	None.	The lack of callouts to identify repair parts without a part/reference number will cause delays in completion of maintenance operations.

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
2.1 The test item exhibited marginal safety hazards in several areas (para 2.1).	None.	The sharp corners, edges, and component pins protruding through printed circuit boards constitute marginal hazard for personnel injury. Exposed voltages in excess of 70 volts constitute a marginal hazard due to personnel injury. There is no label warning operator-maintainer-logistic personnel of special handling requirements.
2.2 The built-in test facility was found to be inadequate for isolating all defective plug-in modules (para 2.24).	None.	Three units failed during the (BITE) test.
2.3 The plug-in modules and power supply modules were difficult to seat (para 2.25).	None.	The mechanical problem of seating the modules could impact mission performance since it does delay corrective action.
2.4 The test item did not withstand the effects of humidity (para 2.28).	Use premium quality, corrosion resistant parts throughout.	The TD-1069 showed visible corrosion on front cover retaining screws, power and phone ON/OFF switches, switch gate assemblies, printed circuit boards, inside top covers, inside the back cover and power supply modules.

Shortcoming	Suggested Corrective Action	Remarks
2.5 The test item did not withstand the effects of salt fog (para 2.31).	Use premium quality, corrosion resistant parts throughout.	The salt fog test revealed corrosion on front cover retaining screws, power and phone ON/OFF switches, power and alarm lamp housings, test meter screws, cable connectors, solder junc- There were also two defective modules in SN 17.
2.6 The test item did not withstand the effects of fungus (para 2.32).	The gaskets and ties should not be mde of materials subject to fungi attack. The surfaces of the tracks of the PCB cards must be sprayed with a suitable fungicide.	The TD-1069 supported fungal growth in the following areas: exterior surface, top interior, back interior, front panel (external), and power supply.
2.7 The design for maintainability is inadequate (para 2.40.5).	None.	The limited accessibility, misalignment of the connectors, failues of the power supply, difficulty in replacing the power supply, difficulty in removing the card extractor and the disassembly of the power supply assembly case to replace the retaining (rubber "D") ring is prejudicial to the ease of maintenance. The failures of the power supplied, wearing of the baseplate and slotted head on the guide pin receptacles demonstrates a weakness in design.

Shortcoming	Suggested Corrective Action	Remarks
2.8 The human engineering characteristics were found to be inadequate (para 2.41).	None.	The color scheme (light lettering on dark background) on display panel is not consistent with the ATACS system. The large size of the data/timing cable connectors and the close spacing at the rear of the test item made removal/installation difficult. The channel assignment switch was placed in an inaccessible location.

APPENDIX C - MAINTENANCE EVALUATION

MAINTENANCE ANALYSIS CHART INSTRUCTION SHEET

DESCRIPTION

COLUMN

1 GROUP AND SEQUENCE NUMBERS. FUNCTIONAL GROUP NUMBER AS INDICATED IN THE MAINTENANCE ALLOCATION CHART (OR TB-750-93-1) OF THE ASSEMBLY OR SUBASSEMBLY. THE SEQUENCE NUMBER OF THE MAINTENANCE ACTION IS IN PARENTHESES BELOW THE GROUP NUMBER.

2 COMPONENT AND RELATED OPERATIONS. COMPONENT AND RELATED MAINTENANCE FUNCTIONS AS INDICATED IN THE MAINTENANCE ALLOCATION CHART. MAINTENANCE FUNCTIONS ASSIGNED TO DEPOT CATEGORY MAINTENANCE ARE NOT NORMALLY SHOWN.

3 SUBSYSTEM ID. A SUBSYSTEM IDENTIFIER ASSIGNED BY THE TEST AGENCY PRIOR TO THE TEST. EXAMPLE: ENGINE ASSIGNED SUBSYSTEM IDENTIFIER "A," TRANSMISSION ASSIGNED SUBSYSTEM IDENTIFIER "B," ETC.

4 MAINTENANCE CATEGORY, PRESCRIBED. THE MAINTENANCE CATEGORY PRESCRIBED BY THE MAINTENANCE ALLOCATION CHART IS INDICATED USING THE FOLLOWING CODE: C - OPERATOR/CREW; O - ORGANIZATIONAL; F - DIRECT SUPPORT; H - GENERAL SUPPORT; D - DEPOT.

MAINTENANCE CATEGORY, RECOMMENDED. USE THE CODE LETTERS, C, O, F, H, OR D TO INDICATE THE MAINTENANCE CATEGORY RECOMMENDED BY THE TEST AGENCY.

MAINTENANCE CATEGORY, ACTUAL. THE ACTUAL MAINTENANCE LEVEL AT WHICH THIS TASK WAS PERFORMED AT THE TEST AGENCY.

5 TM INSTRUCTIONS, ADEQUATE. AN X IN THIS COLUMN INDICATES THE TM INSTRUCTIONS COVERING THIS MAINTENANCE TASK OR ACTION ARE ADEQUATE.

TM INSTRUCTIONS, INADEQUATE. WHEN THE TM INSTRUCTIONS ARE CONSIDERED INADEQUATE, INSERT THE TEST AGENCY EPR NUMBER (IF APPROPRIATE) WHICH TRANSMITTED THE DA FORM 2028.

EPG FORM 1313A (REV)
3 AUG 1974

SUPERSEDES EPG FORM 1313A, DTD 15 JUL 1973 WHICH IS OBSOLETE.

COLUMN

6 ACTIVE MAINTENANCE TIME. MANHOURS AND CLOCK HOURS REQUIRED FOR THE MAINTENANCE OPERATION TO THE NEAREST TENTH OF AN HOUR. ELAPSED HOURS ARE THE TOTAL HOURS THAT THE MAINTENANCE ACTION REQUIRED INCLUDING ALL DELAYS. IF THE OPERATION WAS NOT ACTUALLY PERFORMED BUT WAS REVIEWED, THE ESTIMATED ACTIVE MAINTENANCE TIME IS INDICATED BY USING THE PREFIX E. (UNUSUAL DIFFERENCES IN MAINTENANCE TIMES FOR THE SAME OPERATION SHOULD BE EXPLAINED IN THE BODY OF THE TEST REPORT.)

7 SYSTEM LIFE. THE NUMBER OF OPERATIONAL HOURS (ESSENTIAL) AND MILES, ROUNDS, EVENTS, ETC., AS REQUIRED IN THE TEST PLAN, ACCUMULATED DURING THE TEST BEFORE MALFUNCTION OR SCHEDULED SERVICE OCCURRED. (UNDER THE LIFE FIGURE, ENTER IN PARENTHESES THE SEQUENCE NUMBER FOR WHICH THAT PARTICULAR OPERATION WAS LAST PERFORMED FOLLOWED BY THE APPROPRIATE LIFE UNIT; I.E., M, H, R, ETC.). "S" WILL BE PLACED IN THIS COLUMN IF THE OPERATION WAS PERFORMED ON A SAMPLING BASIS AND NOT BECAUSE OF AN ACTUAL MAINTENANCE ACTION.

8 DIAGNOSTIC TIME. THE PORTION OF MAINTENANCE TIME CLOCK HOURS WHICH WERE USED TO DIAGNOSE THE MALFUNCTION.

9 REASON PERFORMED. THE SYMBOL "UNSCHED" WILL BE ENTERED IN THIS COLUMN IF THIS OPERATION WAS PERFORMED AS A RESULT OF UNSCHEDULED MAINTENANCE. IF THE OPERATION WAS PERFORMED AND RECORDED AS A REQUIRED PORTION OF A SCHEDULED MAINTENANCE SERVICE, THE SYMBOL "SCHED" WILL BE USED. IF THE OPERATION WAS PERFORMED ONLY TO VERIFY PROCEDURES OR TOOL REQUIREMENTS, NOT TO CORRECT A MALFUNCTION, THE SYMBOL "SIM" WILL BE ENTERED.

NOTE. SEPARATE MAINTENANCE ANALYSIS CHARTS WILL BE USED TO RECORD SIMULATED MAINTENANCE ACTIONS.

10 REMARKS. WHEN AN EPR IS RELATED TO A MAINTENANCE OPERATION, THE EPR NUMBER IS ENTERED. THE REMARKS COLUMN WILL BE USED TO IDENTIFY MAINTENANCE FUNCTIONS WHICH ARE CONSIDERED FAILURES FOR RELIABILITY COMPUTATIONS. THE TIME IN MANHOURS PRESCRIBED BY THE MAC TO PERFORM EACH FUNCTION WILL ALSO BE ENTERED HERE OR LOCALLY DEVISED FORMS MAY REQUIRE ENTRY OF THE INFORMATION IN A SEPARATE COLUMN. CSF DENOTES CHARGEABLE SYSTEM FAILURE.

EPG FORM 1313A (REV)
3 AUG 1974

SUPERSEDES EPG FORM 1313A, DTD 15 JUL 1973 WHICH IS OBSOLETE.

MAINTENANCE ANALYSIS CHART	PROJECT NO. 6-FE-TD1-069-001	NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069	IDENTIFICATION NO. 9	PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	S U B	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5		6			7	8	9	10
0001 (1 A)	INITIAL INVENTORY AND INSPECTION		O	O	O	X		0.2 NC	0.4 NC	0.2	0.0 -H	0.1	SCHED	BENT TEST PINS MAC WORK MEAS TIME (NOT LISTED) EPR KH-2
0103 (1 B)	COMMON CHANNEL PORT MODULE SM-D-317360 REPLACED IAW DTM 11-5805-038-12. FOUND DURING INITIAL INSPECTION.		O	O	O	X		0.5	0.5	0.5	0.0 -H	0.2	UNSCHED	FAULTY MODULE ON ONE DATA RATE AND ONE CHANNEL ONLY, THAT BEING CHANNEL SIX ON THE 9600 DATA RATE. TROUBLE ISOLATED USING TROUBLE SHOOTING CHART. MAC TIME (NOT LISTED) EPR KH3

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TD1-049-001 | NUMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 10 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SURTD	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADDT	INADDT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5			6		7	8	9	10
0001 (1)	INITIAL INVENTORY AND INSPECTION		O	O	O	X		0.2 NC	0.4	0.2 NC	0.0 -M	0.1	SCHED	RENT TEST PINS MAC MEAS TIME (NOT LISTED) FPR KH-2

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TD1-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 12 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	S U R I D	MAINTENANCE LEVEL (C-OPERATOR/CREW, O-ORGANIZATION, F-DIRECT, H-GENERAL, D-DEPOT) PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE M-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5			6		7	8	9	10
0001 (1.1)	INITIAL INVENTORY AND INSPECTION		O	O	O	X		0.2 MC	0.4	0.2 MC	0.0 -M	0.1	SCHED	BENT TEST PINS MAC MEAS TIME (NOT LISTED) EPR KM-2

3

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TD1-069-001 | NUMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 13 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SUB	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5		6			7	8	9	10
0001 (1)	INITIAL INVENTORY AND INSPECTION		O	O	O	X		0.2 NC	0.4	0.2 NC	0.0 -H	0.1	SCHED	RENT TEST PINS MAC MEAS TIME (NOT LISTED) EPR KH-2
0000 (2)	REPLACED SN 13 WITH SN 16 AFTER 333 HOURS INTO RELIABILITY		C	C	C	X		0.0	0.0	0.0	333.00-H	0.0	UNSCHED	SN 13 WOULD GO INTO FUNCTIONAL ALARM DURING VIBRATION PORTION OF RELIABILITY TEST ECOM PERSONNEL LATER DISCOVERED A BROKEN WIRE IN THE SWITCH GATE ASSEMBLY. CSP EPR KH-4

4

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TD1-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 16 | PAGE 1

SP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	S U B I D	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE M-HOURS K-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5			6		7	8	9	10
0001 (1 A)	INITIAL INVENTORY AND INSPECTION		O	O	O	X		0.2 MC	0.4	0.2 MC	0.0 -H	0.1	SCHED	BENT TEST PINS MAC MEAS TIME (NOT LISTED) EPR KH-7
0108 (1 B)	MODULE A17 REFERENCE FREQUENCY GENERATOR CARD REPLACED IAW DT M 11-5805-636-12		O	O	O	X		0.5	0.5	0.5	0.0 -H	0.3	UNSCHED	TROUBLESHOOTING CHART ISOLATED MODULE A17 WHICH CAUSED A FREQUENCY DRIFT.MAC MEAS TIME (NOT LISTED). INITIAL INSPECTION EPR KH3
0103 (2)	REPLACED PORT MODULE CHANNEL 3 SN 8048		O	O	O	X		0.2	0.2	0.2	TT8.00-H	0.1	UNSCHED	NO TRANSMIT OR RECEIVE ON CHANNEL 3, BITE INDICATED INOPERATIVE PORT MODULE, REPLACEMENTPART SN 438 CORRECTED PROBLEM.MAC MEAS TIME (NOT LISTED) CSF EPR KH13

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MAINTENANCE ANALYSIS CHART

PROJECT NO. 6-EF-TD1-069-001

NUMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069

IDENTIFICATION NO. 17

PAGE 1

GP. NO. (SEQ. NO) 1	COMPONENT AND RELATED OPERATIONS 2	SUB ID 3	MAINTENANCE LEVEL (C-OPERATOR/CREW, O-ORGANIZATION, F-DIRECT, H-GENERAL, D-DEPOT) PRE 4	REC	ACT	TM INSTRUCTIONS ADQT 5	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS 6	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS 7	DIAG TIME 8	REASON PERFORMED 9	REMARKS 10
0001 (1 A)	INITIAL INVENTORY AND INSPECTION	I	O	O	O	X		0.2 NC	0.4	0.2 NC	0.0 -H	0.2	SCHED	CHECKED GOOD MAC MEAS TIME (NOT LISTED)
0103 (1 B)	COMMON CHANNEL PORT MODULE SM-D-317360 REPLACED IAW DTM 11-5805-638-12	I	O	O	O	X		0.5	0.5	0.5	0.0 -H	0.3	UNSCHED	REPLACED FAULTY PORT MODULE USING TROUBLESHOOTING PROCE DURES WHEN WITH AUDIO ALARM SOUNDED. MAC MEAS TIME (NOT LISTED). INITIAL INSPECTION EPR KH3
0102 (2 A)	REPLACED POWER SUPPLY MODULE A1 SN-04 IAW DTM 11-5805-638-12	I	O	O	O	X		0.5 *	0.5	0.5	13.50-H	0.2	UNSCHED	POWER SUPPLY KEPT BLOWING FUSES AS A RESULT OF THE FUNGUS TEST MAC MEAS TIME (NOT LISTED) EPR KH6
0102 (2 B)	REPLACED BAD DIODE CR1 ON 1A1 BOARD IN POWER SUPPLY IAW DTM 11-5805-638-34. POWER SUPPLY REPLACED AT ORGANIZATIONAL LEVEL	I	F	F	F	X		1.5 NC	-.0	1.5 NC	13.50-H	0.8	UNSCHED	DIODE CR1 OPEN ON 1A1 BOARD ONE OF REASONS FOR POWER SUPPLY FAILURE.MAC MEAS TIME (NOT LISTED). POST-FUNGUS TEST EPR KH6
0102 (2 C)	REPLACED RESISTOR R1 IN POWER SUPPLY MODULE A1 (SN 04) IAW DTM 11-5805-638-34.POWER SUPPLY REPLACED AT ORG LEVEL.	I	F	F	F			1.0 NC	2.0	1.0 NC	13.50-H	0.6	UNSCHED	R1 BURNED OUT IN POWER SUPPLY AS A RESULT OF TROUBLESHOOTING NOT IN ACCORDANCE WITH EQUIPMENT PUBLICATIONS. MAC MEAS TIME (NOT LISTED). POST-FUNGUS TEST EPR KH6

* INDICATES MAINTENANCE ACTION WAS A RESULT OF ENVIRONMENTAL TESTING

6

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TD1-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 20 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	S U B I D	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5		6			7	8	9	10
0000 (1)	INITIAL INVENTORY AND INSPECTION IAW DTR 11-5805-630-12		D	D	D	X		0.2 NC	0.4	0.2 NC	0.0 -H	0.1	SCHED	RENT TEST PINS MAC MEAS TIME (NOT LISTED) FOR KM-2

C-9

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TDI-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 21 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SUB	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5			6		7	8	9	10
0001 (1)	INITIAL INVENTORY AND INSPECTION IAW DTM 11-5805-638-12	I	O	O	O	X		0.2 NC	0.4	0.2 NC	0.0 -H	0.1	SCHED	BENT TEST PINS MAC MEAS TIME (NOT LISTED) EPR KH-7
0102 (2 A)	REPLACED POWER SUPPLY SN-02 WHEN UNIT FAILED TO POWER UP.REPLACED WITH POWER SUPPLY SN# 12.HUMIDITY SUBTEST(FIRST CYCLE)	I	O	O	O	X		0.4 *	0.4	0.4	39.00-H	0.2	UNSCHED	PARTS FROM UNIT WERE TAKEN TO REPAIR POWER SUPPLY SN-15.POWER SUPPLY SN-02 WAS WORKING NORMALLY AFTER DRYING OUT BEFORE PARTS WERE UTILIZED.MAC MEAS TIME(NOT LIST) EPR KH11
0102 (2 B)	REPLACED POWER SUPPLY SN-12 WHEN UNIT FAILED TO POWER UP.IAW DTM 11-5805-638-12		O	O	O	X		0.3 *	0.3	0.3	39.00-H	0.1	UNSCHED	POWER SUPPLY FAILED TO POWER UP AT THE END OF SECOND HUMIDITY CYCLE.MAC MEAS TIME (NOT LISTED) EPR KH11
0102 (3)	REPLACED POWER SUPPLY MODULE A1 SN-8 AFTER FAILING 24 HOURS INTO SYSTEMS TEST	I	O	O	O	X		0.3	0.3	0.3	53.00-H	0.1	UNSCHED	POWER SUPPLY WOULD SHUT ITSELF OFF APPROXIMATELY EVERY HALF HOUR.MAC MEAS TIME NOT LISTED.MAINTENANCE PERFORMED IAW DTM11-5[illegible]5-638-12 EPR KH16

* INDICATES MAINTENACE ACTION WAS A RESULT OF ENVIRONMENTAL TESTING

8

MAINTENANCE ANALYSIS CHART

PROJECT NO. 6-FE-T01-069-001

NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069

IDENTIFICATION NO. 22

PAGE 1

GP. NO. (SEQ. NO) 1	COMPONENT AND RELATED OPERATIONS 2	S U B I D 3	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE 4	REC	ACT	TM INSTRUCTIONS ADQT INADQT 5	ACTIVE MAINTENANCE TIME CLOCK HOURS 6	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS 7	DIAG TIME 8	REASON PERFORMED 9	REMARKS 10
0001 (1)	INITIAL INVENTORY AND INSPECTION		O	O	O	X	0.2 NC	0.4	0.2 NC	0.0 -H	0.1	SCHED	BENT TEST PINS MAC MEAS TIME (NOT LISTED) EPR KH-2
0102 (2 A1)	REPLACED POWER SUPPLY SERIAL NO 08 IAW DTM 11-5805-638-12. REPLACED WITH POWER SUPPLY SN-25.	I	O	O	O	X	0.3 *	0.3	0.3	77.00-H	0.1	UNSCHED	POWER SUPPLY FAILED TO POWER.UP AT THE END OF FIRST 48 HOURS OF HUMIDITY TEST.MALFUNCTION WAS CORRECTED WHEN POWER SUPPLY WAS REPLACED.MAC MEAS TIME (NOT LISTED) EPR KH11
0102 (2 B1)	POWER SUPPLY FAILURE SN-25E/M IAW DTM 11-5805-638-12	I	O	O	O	X	0.3 *	0.3	0.3	77.00-H	0.1	UNSCHED	AT THE END OF SECOND HUMIDITY CYCLE POWER SUPPLY FAILED TO POWER UP.TEST METER INDICATED OUTPUT VOLTAGES WERE LOW EPR KH11
0102 (2 C1)	REPLACED MICA INSULATOR ON 1A1CR1 BOARD IN POWER SUPPLY SN-25E/M IAW DTM11-5805-638-34.POWER SUPPLY REPLACED AT ORGANIZ.	I	F	P	F	X	1.5 NC	3.0	1.5 NC	77.00-H	0.4	UNSCHED	WHEN TROUBLESHOOTING POWER SUPPLY OUTPUT VOLTAGES CR1. INSULATION ON BRIDGE RECTIFIER INPUT CIRCUIT WAS SHORTED TO GROUND ACCIDENTALLY. HUMIDITY SUBTEST EPR KH11
0000 (3)	REPLACED SN 22 WITH SN 10 AFTER 45 HOURS OF SYSTEM TEST.		C	C	C		0.0 NC	0.0	0.0 NC	124.00-H	0.0	UNSCHED	SN 22 WOULD GO INTO FUNCTIONAL ALARM EVERY 10 TO 20 MINUTES. EPR KH-17

* INDICATES MAINTENANCE ACTION WAS A RESULT OF ENVIRONMENTAL TESTING

9

MAINTENANCE ANALYSIS CHART

PROJECT NO. 6-EE-TD1-069-001

NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069

IDENTIFICATION NO. 24

PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	S U B I D	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADDT	INADDT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5			6		7	8	9	10
0001 (1 A)	INITIAL INVENTORY AND INSPECTION		O	O	O	X		0.2 MC	0.4	0.2 MC	0.0 -H	0.1	SCHED	BENT TEST PINS MAC MEAS TIME (NOT LISTED) EPR KH2
0103 (1 B)	COMMON CHANNEL PORT MODULE BAD SN-516B IAW DTM 11-5805-638-12		O	O	O	X		0.4	0.4	0.4	0.0 -H	0.2	UNSCHED	TROUBLESHOOTING CHART ISOLATED A22 AS FAULTY REPLACEMENT OF THIS MODULE RESTORED NORMAL OPERATION. MAC MEAS TIME (NOT LISTED). INITIAL INSPECTION EPR KH3
0103 (1 C)	COMMON CHANNEL PORT MODULE FAULTY SN-510 B. IAW DTM 11-5805-638-12.		O	O	O	X		0.3	0.3	0.3	0.0 -H	0.2	UNSCHED	TROUBLESHOOTING CHART ISOLATED SLOT A22 AS BEING BAD MAC MEAS TIME (NOT LISTED). THIS SPARE PORT MODULE WAS FOUND FAULTY WHEN USED TO REPLACE SEQ NO 1B. EPR KH3
0103 (2)	BAD COMMON PORT MODULE REPLACED IAW DTM 11-5805-638-12.		O	O	O	X		0.3	0.3	0.3	264.00-H	0.2	UNSCHED	COMMON CHANNEL PORT MODULE BECAME FAULTY DURING RELIABILITY OPERATIONAL CHECK TEST. MAC MEAS TIME (NOT LISTED) CSF EPR KH12

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MAINTENANCE ANALYSIS CHART — PROJECT NO. 6-EE-TD1-069-001 — NOMENCLATURE: SIMULATED MAINTENANCE FOR TD-1069 SN13 — IDENTIFICATION NO. 13-SIM — PAGE 1

GP. NO. (SEQ. NO) (1)	COMPONENT AND RELATED OPERATIONS (2)	S U B I O (3)	MAINTENANCE LEVEL (C-OPERATOR/CREW, O-ORGANIZATION, F-DIRECT, H-GENERAL, D-DEPOT) PRE (4)	REC	ACT	TM INSTRUCTIONS ADDT (5)	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS (6)	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS (7)	DIAG TIME (8)	REASON PERFORMED (9)	REMARKS (10)
0001 (1 A)	ORGANIZATIONAL MONTHLY AND QUARTERLY PREVENTIVE MAINTENANCE CHECKS AND SERVICES WERE PERFORMED IAW DTM11-5805-638-12		O	O	O	X		0.3E NC	0.3E NC	0.3	0.0 -H	0.0	SIM	MONTHLY AND QUARTERLY REQUIRED 0.3 HOUR EACH.
0001 (1 B)	REPLACED METER A32M1		F	F	F	X		0.7E NC	0.7E NC	0.7	0.0 -H	0.0	SIM	CANNOT OBTAIN READINGS ON METER AS A RESULT OF BEING INOPERATIVE.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0001 (1 C)	REPLACED PHONE BINDING POST A32E1		F	F	F	X		1.0E NC	1.0E NC	1.0	0.0 -H	0.0	SIM	BAD PHONE BINDING POST PREVENTS PHONE HOOKUP.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0001 (1 D)	REPLACED PUSHBUTTON SWITCH A32S1		F	F	F	X		0.7E NC	0.7E NC	0.7	0.0 -H	0.0	SIM	BAD SWITCH PREVENTS RESETTING TEST ITEM.MAINTENANCE PERFORMED IAW DTM11-5805-638-34 MAC MEAS TIME NOT LISTED
0001 (1 E)	REPLACED METER SELECT SWITCH A32S2		F	F	F	X		0.9E NC	0.9E NC	0.9	0.0 -H	0.0	SIM	DEFECTIVE SWITCHPREVENTS MONITORING OF POWER SUPPLY VOLTAGES.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0001 (1 F)	REPLACED AUDIBLE ALARM A32DS4		F	F	F	X		0.8E NC	0.8E NC	0.8	0.0 -H	0.0	SIM	NO AUDIBLE ALARM SOUND AS A RESULT OF BEING DEFECTIVE. MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0001 (1 G)	REPLACED LAMP SOCKET A32XDS1		F	F	F	X		0.7E NC	0.7E NC	0.7	0.0 -H	0.0	SIM	BAD LAMP SOCKET PREVENTS FUNCTIONAL ALARM LIGHT FROM GLOWING.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED

MAINTENANCE ANALYSIS CHART | PROJECT NO. 6-EE-TD1-069-001 | NUMENCLATURE SIMULATED MAINTENANCE FOR TD-1069 SN13 | IDENTIFICATION NO. 13-SIM | PAGE 2

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SUB (S U B T D)	MAINTENANCE LEVEL (C-OPERATOR/CREW, O-ORGANIZATION, F-DIRECT, H-GENERAL, D-DEPOT) PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5		6			7	8	9	10
0001 (1 H)	REPLACED RELAY A32K1		F	F	F	X		1.2E NC	1.2E	1.2 NC	0.0 -H	0.0	SIM	REPLACED BAD RELAY WHICH CAUSED SYNC PROBLEMS.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0001 (1 I)	REPLACED MUX/DEMUX ASSEMBLY A32A6		F	F	F	X		0.7E NC	0.7E	0.7 NC	0.0 -H	0.0	SIM	NO MUX-IN OR DEMUX INTPUT BECAUSE OF BAD ASSEMBLY A32A6.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0102 (1 J)	REPLACED PRINTED WIRING BOARD A1A1 IN POWER SUPPLY		F	F	F	X		1.6E NC	1.6E	1.6 NC	0.0 -H	0.0	SIM	NO AC POWER AS A RESULT OF BAD PRINTED BOARD A1A1 IN POWER SUPPLY.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0102 (1 K)	REPLACED A1CR1 IN POWER SUPPLY		F	F	F	X		1.0E NC	1.0E	1.0 NC	0.0 -H	0.0	SIM	POWER SUPPLY BLOWS FUSES AS A RESULT OF BAD A1CR1.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED
0102 (1 L)	REPLACED AC POWER SWITCH IN POWER SUPPLY		F	F	F	X		0.8E NC	0.8E	0.8 NC	0.0 -H	0.0	SIM	NOAC POWER AS A RESULT OF OPEN SWITCH.MAINTENANCE PERFORMED IAW DTM11-5805-638-34.MAC MEAS TIME NOT LISTED

12

Instructions for
Tools and Test, Measurement, and Diagnostic Equipment (TMDE) Chart

COLUMN

1 Nomenclature or Description. Enter the nomenclature as shown in the manual or if none, enter noun nomenclature and brief description of item. (Enter in parentheses the number of like items received, such "(2 ea)".)

2 Federal Stock Number or Part Number. Enter one of the following: Federal Stock Number, Part Number, or Drawing Number in this order.

3 Maintenance Category, Prescribed. Maintenance category authorized the item as prescribed by the technical publication.

4 Maintenance Category, Recommended. Indicate the maintenance category to be authorized the item as recommended by test agency. If the item is not required, enter none.

5 Date Received. Enter the date the tool or item of TMDE was received (Example 6/69). Enter "not rec" if the tool or test equipment was not received.

6 Evaluation, Adequate. Enter an X if the item was found to be adequate for use by the mechanics and for its intended purpose at the maintenance category recommended in Column 4. Make no comment on items marked "None" in Column 4.

7 Evaluation, Inadequate. Enter an X if the tool was found to be inadequate for its intended use. Make no comment on tools marked "None" in Column 4.

8 Required (RQD) Yes or No. A "Yes" in this column indicates the special tool or test equipment is required at the maintenance level indicated in Column 4. A "No" in this column indicates the special tool or test equipment is not required. This column should be marked "No" when "None" is marked in Column 4.

9 Listed in Technical Manual. Enter the number of the technical publication for the test item in which the tool or test equipment is listed.

10 Remarks. If an EPR is related to the item, the EPR number will be entered. If the item was used only to verify the need for the item, this will be indicated. When it has been determined that an item is not required, indicate the standard item which will perform the required maintenance function if appropriate.

TOOLS AND TMDE CHART	PROJECT NO 6-EE-TD1-069-001			NOMENCLATURE Time Division Digital Multiplexer TD-1069					
NOMENCLATURE OR DESCRIPTION	FSN OR PART NO	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORG F-DIRECT H-GENERAL D-DEPOT		DATE RECEIVED	EVALUATION		RQR YES OR NO	TECHNICAL MANUAL IN WHICH LISTED	REMARKS
		PRESB	RECM		ADQT	INADQT			IC
1	2	3	4	5	6	7	8	9	
Multimeter TS-352D/U	6625-581-2036	O,F,H,D	O,F,H D	Locally ob-tained.	X		Yes	DTM 11-5805-638-12	
Tool Kit TK-101/G	5180-064-5178	O	O	Locally ob-tained.	X		Yes	DTM 11-5805-638-12	
Oscilloscope AN/USM-281A	6625-228-220	F,H,D	F,H,D	Locally ob-tained.	X		Yes	DTM 11-5805-638-12	
Ammeter ME-65/U	6625-985-5251	F,H,D	F,H,D	Locally ob-tained.	X		Yes	DTM 11-5805-638-12	The SIMPSON 390 volt, amp, and watt meter was used in lieu of the ammeter ME-65/U.
Power Supply (2 required)	6625-051-5986	F,H,D	F,H,D	Locally ob-tained.	X		Yes	DTM 11-5805-638-12	
Powerstat	5950-587-9395	F,H,D	F,H,D	Locally ob-tained.	X		Yes	DTM 11-5805-638-12	

STEEP-MT-E Form 7
1 Aug 75

Replaces STEEP-MT-E Form 7 dated 1 May 74

TOOLS AND TMDE CHART

PROJECT NO 6-EE-TD1-069-001

NOMENCLATURE Time Division Digital Multiplexer TD-1069

NOMENCLATURE OR DESCRIPTION	FSN OR PART NO	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORG F-DIRECT H-GENERAL D-DEPOT		DATE RECEIVED	EVALUATION		RQR YES OR NO	TECHNICAL MANUAL IN WHICH LISTED	REMARKS
		PRESB	RECM		ADQT	INADQT			
1	2	3	4	5	6	7	8	9	10
Isolation Transformer	5950-583-4206	F,H,D	F,H,D	15Aug75	X		Yes	DTM 11-5805-638-12	
Load Resistor, Variable (0-30 ohms, 200 watts)	N/A	F,H,D	F,H,D	15Aug75	X		Yes	DTM 11-5805-638-12	For the 2 variable load resistors, 0-30 ohms, 200 watts and 0-72 ohms, 100 watts, the General Radio decade resistor SN 7097 was used in lieu of the 2 variable load resistors.
Load Resistor, Variable (0-72 ohms, 100 watts)	N/A	F,H,D	F,H,D	15Aug75	X		Yes	DTM 11-5805-638-12	
Connector, 9 pin M24308/2-23	N/A	F,H,D	F,H,D	15Aug75	X		Yes	DTM 11-5805-638-12	
Connector, 15 pin M24308/2-24	N/A	F,H,D	F,H,D	15Aug75	X		Yes	DTM 11-5805-638-12	
Tool Kit, TK-105/G	5180-610-8177	F,H,D	F,H,D	N/A		X	Yes	DTM 11-5805-638-12	Tools contained in tool kit TK-105/G are inadequate. Tools cannot be used to remove hex nut off of connectors.

STEEP-MT-E Form 7

Replaces STEEP-MT-E Form 7 dated 1 May 74

TOOLS AND TMDE CHART	PROJECT NO 6-EE-TD1-069-001			NOMENCLATURE Time Division Digital Multiplexer TD-1069					
NOMENCLATURE OR DESCRIPTION	FSN OR PART NO	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORG F-DIRECT H-GENERAL D-DEPOT		DATE RECEIVED	EVALUATION		RQR YES OR NO	TECHNICAL MANUAL IN WHICH LISTED	REMARKS
		PRESB	RECM		ADQT	INADQT			
1	2	3	4	5	6	7	8	9	10
Diode IN645 (2 required)	5961-235-0116	F,H,D	F,H,D	N/A	X		Yes	DTM 11-5805-638-12	
Digital Voltmeter AN/GSM-64	6625-870-2264	F,H,D	F,H,D	N/A	X		Yes	DTM 11-5805-638-12	The 3440 H.P. was used in lieu of the digital voltmeter AN/GMS-64 for all test required use of this meter.

STEEP-MT-E Form 7
1 Aug 75

Replaces STEEP-MT-E Form 7 dated 1 May 74

Instructions for Maintenance Package Literature Chart

COLUMN

1 Number. Enter Army or manufacturer's publication or draft manual number.

2 Quantity. Number of copies received. Insert "0" if none were supplied. Use Chapter 9, AR 310-3, as a guide to determine those publications that should accompany the test item. Publications contained in the maintenance test package should cover operations and functions through general support maintenance and should specify the categories involved.

3 Title. Complete title.

4 Date Received, Literature. Enter date publication was received.

5 Date Received, Materiel. Enter date test item or materiel was received.

6 & 7 Evaluation. Insert "X" in appropriate block. Minor errors noted on DA Form 2028 are not in themselves sufficient reasons to term a publication inadequate.

8 Form 2028. Insert EPR number (if appropriate) and date DA Form 2028 was forwarded.

9 Remarks. In addition to appropriate remarks, explain if manuscript was not evaluated and the reason therefor.

STEEP-MT-E Form 11a

1 Aug 75

MAINTENANCE PACKAGE LITERATURE CHART

PROJECT NO: 6-EE-TD1-069-001

NOMENCLATURE: Time Division Digital Multiplexer TD-1069

MANUSCRIPT			DATE RECEIVED		EVALUATION		FORM 2028	REMARKS
NUMBER	QTY	TITLE	LIT	MATERIEL	ADQT	INADQT	DATE FORWARDED	
1	2	3	4	5	6	7	8	9
DTM 11-5805-638-12	10	Operator and Organizational Maintenance Manual for Multiplexer, Time Division, Digital TD-1069 Apr 75	25Jun75	25Jun75	X			
DTM 11-5805-638-34	10	Direct Support and General Support Maintenance Manual for Multiplexer, Time Division, Digital TD-1069 Apr 75	25Jun75	25Jun75	X			
PDEF 11-5805-( )-12P	1	Organizational Maintenance Repair Parts and Special Tools List for, Multiplexer, Time Division, Digital TD-1069 Mar 75	3Nov75	3Nov75	X			
PDEF 11-5805-( )-34P	1	Direct Support, General Support, and Depot Maintenance Repair Parts and Special Tools List for Multiplexer, Time Division, Digital TD-1069 Mar 75	3Nov75	3Nov75		X		It is difficult and in some instances impossible to cross reference nomenclature of parts with that in parts manual.

STEEP-MT-E Form 11
1 Aug 75

PARTS ANALYSIS CHART INSTRUCTION SHEET

GENERAL. THE PARTS ANALYSIS CHART PROVIDES FOR A LISTING OF THE PARTS USED IN MAINTAINING THE TEST ITEM. PARTS WILL BE GROUPED ON THIS CHART BY FUNCTIONAL GROUP AND IN FEDERAL STOCK NUMBER (FSN) NUMERICAL ORDER WITHIN EACH GROUP.

COLUMN	DESCRIPTION
1	GROUP AND SEQUENCE NUMBER. PARTS USAGE BY MAINTENANCE OPERATION IS INDICATED BY A CROSS REFERENCE TO THE GROUP NUMBER AND SEQUENCE NUMBER FROM COLUMN 1 OF THE MAINTENANCE ANALYSIS CHART.
2	FEDERAL STOCK NUMBER. RECORD THE FEDERAL STOCK NUMBER, TECHNICAL SERVICE PART NUMBER, MANUFACTURERS PART NUMBER, OR DRAWING NUMBER IN THIS ORDER OR PREFERENCE.
3	NOUN NOMENCLATURE. AS LISTED IN THE PARTS MANUAL.
4	MAINTENANCE LEVEL, PRESCRIBED. THE MAINTENANCE LEVEL PRESCRIBED BY THE PARTS LIST UNDER REVIEW. USE THE CODE C – OPERATOR/CREW, O – ORGANIZATIONAL, F – DIRECT SUPPORT, H – GENERAL SUPPORT, D – Depot.
5	MAINTENANCE LEVEL, RECOMMENDED. THE CODE SYMBOLS C, O, F, H, or D INDICATE THE MAINTENANCE LEVEL RECOMMENDED BY THE TEST AGENCY.
6	PART LIFE. THE NUMBER OF OPERATING HOURS (ESSENTIAL) AND MILES, ROUNDS, EVENTS, ETC., AS REQUIRED BY THE TEST PLAN, ACCUMULATED BY THIS PART. THIS IS ACTUAL PART LIFE AND SHOULD AGREE WITH THE PART LIFE REPORTED ON THE EPR. EACH ENTRY IN THIS COLUMN IS FOLLOWED BY THE APPROPRIATE LIFE UNIT SYMBOL (H, M, OR R).
7	REASON USED. THE SYMBOL UNSCHED WILL BE ENTERED IN THIS COLUMN IF THIS PART WAS USED AS A RESULT OF UNSCHEDULED MAINTENANCE. IF THE PART WAS REPLACED AS A REQUIRED ACTION OF SCHEDULED MAINTENANCE, THE SYMBOL SCHED WILL BE ENTERED. IF THE PART WAS USED AS A TIME CHANGE COMPONENT, TCC WILL BE ENTERED. IF THE PART WAS CONSUMED TO VERIFY PROCEDURES OR TOOLS, NOT TO CORRECT A MALFUNCTION, THE SYMBOL SIM WILL BE ENTERED.
8	REMARKS. IF AN EPR IS RELATED TO THE PART USED, THE EPR NUMBER WILL BE INSERTED IN THIS COLUMN. WHEN THE PART WAS REPLACED TO CORRECT A FAILURE, IT WILL BE INDICATED BY INSERTING THE WORD FAILURE IN THIS COLUMN.

EPG Form 1316 A (Rev) 15 Jul 1973 — Supersedes EEP Form 1316 A, 1 Oct 70, which is obsolete

PARTS ANALYSIS CHART | PROJECT NO. 6-EE-TD1-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 9 | PAGE 1

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRESR	RFCM	PART LIFE H-HOURS M-MILES R-ROUNDS	REASON USED	REMARKS
1	2	3	4	5	6	7	8
0103 (1 8)	SM-D-317340 (1EA)	COMMON CHANNEL PORT MODULE	O	O	0.0 -H	UNSCHED	TROUBLE ISOLATED USING TROUBLESHOOTING CHART FOR KM3

PARTS ANALYSIS CHART | PROJECT NO. 6-FE-T01-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 1A | PAGE 1

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRESB	RFCM	PART LIFE H-HOURS M-MILES R-ROUNDS	REASON USED	REMARKS
1	2	3	4	5	6	7	8
0103 (2)	SM-D-317360 (1EA)	COMMON CHANNEL PORT MODULE	O	O	178.00-H	UNSCHED	CSF EPR KH13
0108 (1 8)	SM-D-317384 (1EA)	REFRENCE FREQUENCY GENERATOR CARD A17	O	O	0.0 -H	UNSCHED	FAULTY MODULE ISOLATED BY TROUBLESHOOTING CHART EPR KH3

PARTS ANALYSIS CHART	PROJECT NO. 6-EE-TDI-069-001	NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069	IDENTIFICATION NO. 17	PAGE 1

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRESR	RFCM	PART LIFE H-HOURS M-MILES R-ROUNDS	REASON USED	REMARKS
1	2	3	4	5	6	7	8
0000 (1 B1(	SM-D-317360 1EA)	COMMON CHANNEL PORT MODULE	O	O	0.0 -H	UNSCHED	FAULTY MODULE ISOLATED BY TROUBLESHOOTING CHART EPR KH3
0102 (2 B1(	JAN1N3029B 1EA)	SEMICONDUCTOR DEVICE-DIODE	F	F	13.50-H	UNSCHED	BAD DIODE ON 1A1 BOARD IN POWER SUPPLY EPR KH6
0102 (2 C1(	RER60F2R05M 1EA)	RESISTOR R1 FIXED WIRE WOUND	F	F	13.50-H	UNSCHED	RESISTOR BURNED OUT IN POWER SUPPLY REPLACED EPR KH6
0102 (2 A1(	SM-D-317356 1EA)	POWER SUPPLY MODULE A1 ISN-04	O	O	13.50-H	UNSCHED	POWER SUPPLY BLEW FUSES A RESULT OF FUNGUS TEST EPR KH6

3

PARTS ANALYSIS CHART

PROJECT NO. 6-FE-TD1-069-001

NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069

IDENTIFICATION NO. 21

PAGE 1

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRESB	RECM	PART LIFE H-HOURS M-MILES R-ROUNDS	REASON USED	REMARKS
1	2	3	4	5	6	7	8
0102 (2 A)	SM-D-317356 (1EA)	POWER SUPPLY SN 02 REPLACED WITH SN 12	O	O	39.00-H	UNSCHED	UNIT FILED TO POWER UP FPR KH11
0102 (2 B)	SM-D-317356 (1EA)	POWER SUPPLY SN8 12 REPLACED WITH SN 8	O	O	39.00-H	UNSCHED	POWER SUPPLY FAILED TO POWER UP AFTER HUMIDITY FPR KH11
0102 (3)	SM-D-317356 (1EA)	POWER SUPPLY MODULE SN-8	O	O	53.00-H	UNSCHED	POWER SUPPLY REPLACED IAW DTM11-5805-630-12 FPR KH16

H

PARTS ANALYSIS CHART — PROJECT NO. 6-FE-TD1-069-001 — NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 — IDENTIFICATION NO. 22 — PAGE 1

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRESR	RECM	PART LIFE H-HOURS M-MILES R-ROUNDS	REASON USED	REMARKS
1	2	3	4	5	6	7	8
0102 (2 A)(1EA)	SM-D-317356	POWER SUPPLY SN-08 REPLACED WITH SN 25	O	O	77.00-H	UNSCHED	FAILED TO POWER UP AFTER 48 HRS OF HUMIDITY TEST EPR KH11
0102 (2 B)(1EA)	SM-D-317356	POWER SUPPLY SN-25E/H REPLACED WITH SN 2	O	O	77.00-H	UNSCHED	POWER SUPPLY HAD LOW OUT PUT VOLTAGES EPR KH11
0102 (2 C)(1EA)	43-82-10	MICA INSULATOR ON 1A1CR1	F	F	77.00-H	UNSCHED	REPLACED INSULATOR WHICH WAS SHORTED TO GROUND EPR KH11

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PARTS ANALYSIS CHART | PROJECT NO. 6-FE-TD1-069-001 | NOMENCLATURE TIME DIVISIONAL DIGITAL MULTIPLEXER TD-1069 | IDENTIFICATION NO. 24 | PAGE 1

GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRESB	RECM	PART LIFE H-HOURS M-MILES R-ROUNDS	REASON USED	REMARKS
1	2	3	4	5	6	7	8
0103 (1 B)(	SM-D-317360 1EA)	COMMON CHANNEL PORT MODULE	O	O	0.0 -H	UNSCHED	TROUBLE ISOLATED USING TROUBLESHOOTING CHART EPR KM3
0103 (1 C)(	SM-D-317360 1EA)	COMMON CHANNEL PORT MODULE	O	O	0.0 -H	UNSCHED	TROUBLESHOOTING CHART ISOLATED FAULT EPR KM3
0103 (2)(	SM-D-317360 1EA)	COMMON CHANNEL PORT MODULE	O	O	264.00-H	UNSCHED	MODULE FAILED DURING REL IABILITY CHECK TEST CSF EPR KM12

APPENDIX D. SOLDIER-OPERATOR-MAINTAINER TESTER COMMENTS

PART A. SAFETY RELATED

1. The removing of the port module closest to the hinge of the switch gate brackets is dangerous because the port modules are tightly seated and some force must be exerted to extract the circuit card causing the back of the hand to get injured by the gate switch assemblies.

2. The handle on the power supply assembly is too small with the card extractor holder in its present location. When trying to grasp the handle of the power supply assembly to remove the power supply assembly, the fingers get scratched or a firm grip cannot be obtained due to the size of the handle and considering the size and weight of the assembly.

3. There should be a label on the front of the equipment warning the operator-maintainer of the consequences if the common circuit ground and/or the chassis ground are improperly utilized.

PART B. MAINTENANCE RELATED

1. The soldier-operator-maintainer suggests some change in design of component on heat sink in power supply to allow better and easier access to parts and to prevent undue damage to equipment.

2. The soldier operator-maintainer suggests guides or tracks be incorporated to aid in seating the power supply to the power receptacle since the power supply is loosely fitted into the test item and to stop wear of metal baseplate inside the test item.

3. The weather seal gasket in front of the test item is loosely fitted, suggest four additional screws be added, two each top and bottom, evenly spaced.

4. The soldier-operator-maintainer says the major drawback on TD-1069 was replacement of modules when placing a card in a slot, it may or may not fit due to guides being bent or misaligned of printed circuit board (PCB) connectors. The overall performance of the unit was fair, having problems with high and low temperatures, also, humidity. Major areas being replacement of cards and power supplies.

5. Replacement of the card nest assembly A32A3 should be done at depot as it is time consuming and requires special tools and skill. Replacement was approximated to be in the neighborhood of 12 manhours.

APPENDIX E. REFERENCES

1. Test Plan, Development II of Time Division Digital Multiplexer TD-1069, TECOM Project No. 6-EE-TD1-069-001, Publication No. USAEPG-TP-923, July 1975.

2. ECOM Development Specification EL-CP0138-0001A, dated 4 May 1972, and Amendment No. 4 to EL-CP0138-0001A, dated 6 July 1973.

3. Letter, AMCPM-ATC-TR-9, dated 30 January 1973, subject: Coordinated Test Program for Time Division Digital Multiplexer TD-1069( )/G.

4. Military Standard, MIL-STD-454D, Standard General Requirements for Electronic Equipment, 31 August 1973 with Change 1, 1 November 1974.

5. Military Standard, MIL-STD-882, System Safety Program for Systems and Associated Subsystems and Equipment; Requirements for, 15 July 1969.

6. TECOM Supplement 1 to AMCR 385-12, Life Cycle Verification of Materiel Safety, 27 March 1975.

7. Military Standard, MIL-STD-1472B, Human Engineering Design Criteria for Military Systems, Equipment, and Facilities, 31 December 1974.

8. Military Standard, MIL-STD-252B, Wired Equipment, Classification of Visual and Mechanical Defects for, w/Change 1, 19 January 1970.

9. Military Standard, MIL-STD-810B, Environmental Test Method, 15 June 1967, w/Change 4, 21 September 1970.

10. Military Standard, MIL-STD-461A, Electromagnetic Interference Characteristics, Requirement for Equipment, 1 August 1968 w/Notice 4, 9 February 1971.

11. Military Standard, MIL-STD-462, Electromagnetic Interference Characteristics, Measurements of, 31 July 1967, w/Change 3, 9 February 1971.

12. TECOM Supplement 1 to AR 750-1, Army Materiel Maintenance Concepts and Policies, 25 March 1974.

13. Army Regulation, AR 702-3, Army Materiel Reliability, Availability, and Maintainability (RAM), 22 March 1973.

14. Army Regulation, AR 310-3, Preparation, Coordination, and Approval of Department of Army Publications, 20 December 1968.

15. Military Specification, MIL-M-38784, Manuals, Technical: General Requirements for Preparation of, 1 January 1968.

16. Military Specification, MIL-M-63000 (TM), Manuals, Technical: General Requirements for Manuscripts, 18 December 1970.

17. AMC Pamphlet 706-134, Maintainability Guide for Design, October 1972.

18. ECOM Standard, RDD-STD-2, Cases, Transit and Combination, for Electronic Command Equipment.

19. Military Standard, MIL-STD-189, Racks, Electrical Equipment, 19-inch and Associated Panels, 15 November 1955, with Notice 2, 14 March 1961.

20. Military Standard, MIL-STD-188C, Military Communications Systems Technical Standards, 24 November 1969, with Change 1.

21. TECOM Supplement No. 1 to AR 602-1, Human Factors Engineering Program, 4 April 1973.

22. AR 70-10, Test and Evaluation During Research and Development of Materiel, 21 July 1971.

23. AMCR 385-12, Safety Engineering Review of Construction Plans.

24. Military Standard, MIL-STD-781B, Reliability Test Exponential Distribution, with Change 1, 28 July 1969.

25. Proposed Materiel Need (Engineering Development) for Time Division Digital Multiplexer, 5 July 1972.

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APPENDIX F. ABBREVIATIONS

A_a	achieved availability
ASCII	American Standard Code for Information Interchange
ATACS	Army Tactical Area Communications System
BER	bit error rate
b/s	bits per second
CH	channel
CRT	cathode ray tube
dB	decibel(s)
dBm	decibels referenced to 1 milliwatt in 600 ohms
^oC	degrees, Celsius (Centigrade)
^oF	degrees, Fahrenheit
DT II	Development Test II
EW	electronic warfare
Hz	hertz
kb/s	kilobits per second
kHz	kilohertz
MAC	maintenance allocation chart
MAV	minimum acceptable value
MHz	megahertz
MOS	Military Occupational Specialty
$M_{max\ ct}$	maximum corrective maintenance time
MR	maintenance ratio
msec	millisecond(s)
MTBF	mean time between failure
MTTR	mean time to repair
MUX	multiplexer
NRZ	non-return to zero
PCM	pulse code modulation
RCV	receive
RFI	radio frequency interference
rms	root mean square
RPSTL	Repair Parts and Special Tools List
SV	specified value
TMDE	test, measurement, and diagnostic equipment
TTL	transistor-transistor logic
μsec	microsecond(s)
Vp-p	volts peak-to-peak
wpm	words per minute

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